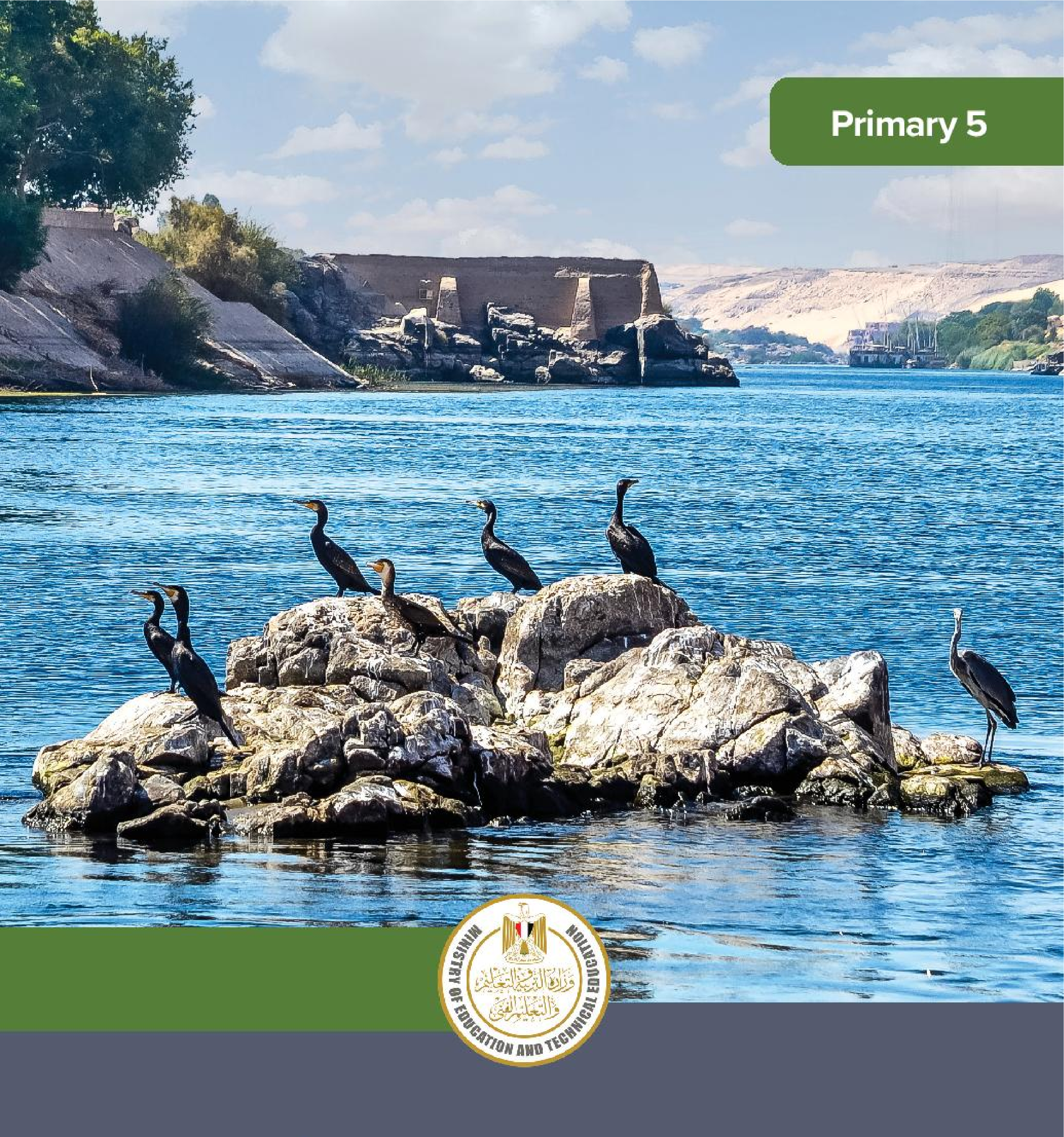


Science Term 1

Primary 5 Science

Name ______________________________

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Reviewed by

The General Administration for Planning and Formulating Curriculum

Supervised by

Dr. Akram Hassan

Head of the Central Administration for the Development of Curricula

FOREWORD

The MOETE launched Egypt's reform vision for the development of education, and the process of developing curricula comes at the heart of this vision. The implementation of this vision was heralded in 2018, starting with the kindergarten stage in its first and second grades, with the aim of continuing until the end of the secondary stage.

This vision endeavored to make major transformations in the teaching and learning processes, where there is a transition from acquiring knowledge to producing it, and from learning skills to employing them both in specific learning situations and in the general life of the learner outside the classroom. Our curricula also integrate values that contribute to the establishment of our society—values which pose as a protective fort for our homeland. Egypt's reform vision for curriculum development also aims to take into account the specifications of pre-university education graduates, as well as the challenges Egypt faces locally, regionally, and globally. The developed curricula are intended to foster a citizen who is capable of engaging in civilized conversations and positive dialogues with the other, in addition to acquiring digital citizenship skills.

In this regard, the MOETE extends its gratitude and appreciation to the Central Administration for the Development of Curricula and Educational Materials. It also extends its thanks and gratitude to Discovery Education for their active participation in the preparation of this book. Gratefulness also goes to all the Ministry's experts who contributed to the enrichment of this work.

This transformation of Egypt's education system would not have been possible without the significant support of Egypt's current president, His Excellency President Abdel Fattah el-Sisi. Overhauling the education system is part of the President's vision of "rebuilding the Egyptian citizen" and it is closely coordinated with the Ministries of Higher Education and Scientific Research, Culture, and Youth and Sports. The new education system is only a part in a bigger national effort to propel Egypt to the ranks of developed countries, and to ensure a great future for all of its citizens.

WORDS FROM THE MINISTER OF EDUCATION & TECHNICAL EDUCATION

Dear students and fellow teachers,

It gives me great pleasure to celebrate this crucial stage of comprehensive and sustainable development, an epic in which all Egyptian people are taking part. This pivotal stage necessitates paving a foundation for a strong educational system which yields a generation that is not only capable of facing the major challenges the world is witnessing today, but one that also has complete possession of the skills of the future. For this reason, the Egyptian state is keen on empowering its citizens by establishing a top-notch educational system that invests in its children the expertise required to get them to compete at both a regional and global level, at a time when the world is witnessing successive industrial revolutions.

This dictates that our educational system has at its core an emphasis on skills development, deep understanding, and knowledge production. This can only be done through modern curricula that keep up with the changes taking place globally-- curricula which prioritize the development of skills and values, and the integration of knowledge. They are also curricula that focus on the provision of multiple learning sources, and integration of technology to enrich the educational process and to improve its outcomes, while addressing the most important contemporary issues.

To achieve this, we must all join hands to continue to revolutionize our education, and to support it with all that is required to transform it into a globally pioneering educational system.

My warmest regards to you, dear students, and my deepest gratitude to my fellow teachers.

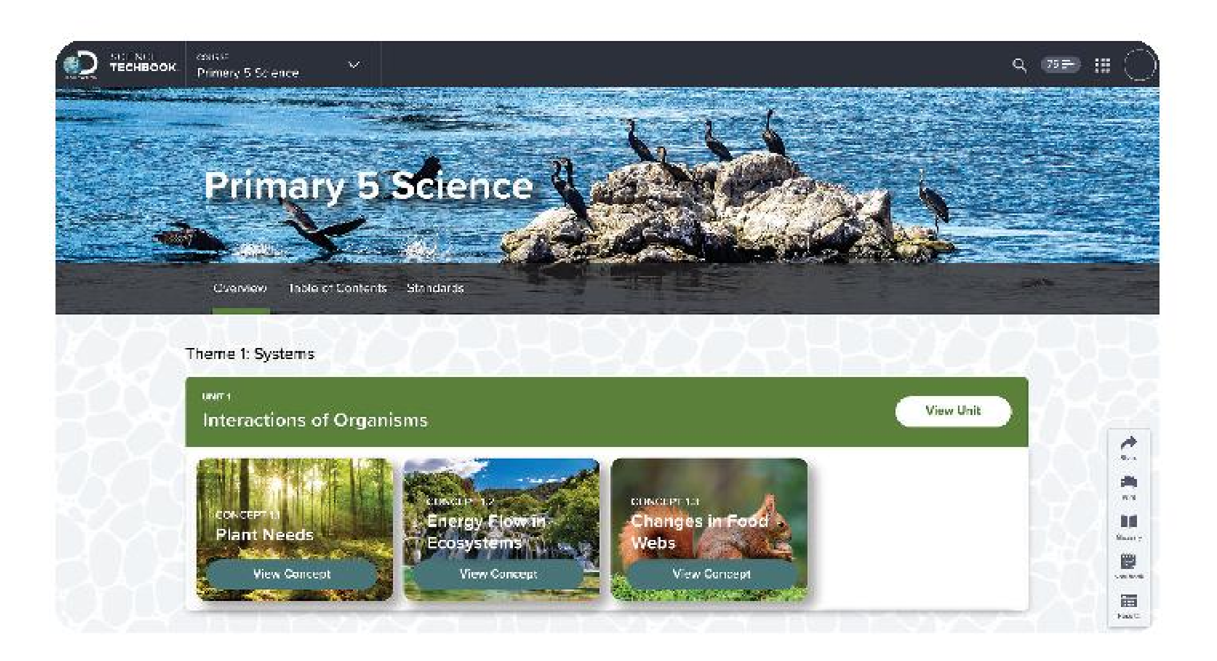
Professor Reda Hegazy

Minister of Education and Technical Education



Dear Parent/Guardian,

This year, your student will be using Science Techbook™, a comprehensive science program developed to inspire students to act and think like scientists and engineers. Throughout the year, students will ask questions about the world around them and solve real-world problems through the application of critical thinking across the domains of science (Life Science, Earth and Space Science, Physical Science, Environmental Science, and Engineering).



Science Techbook is an innovative program that helps your student master key scientific concepts. Students engage with interactive science materials to analyze and interpret data, think critically, solve problems, and make connections across science disciplines. Science Techbook includes dynamic content, videos, digital tools, hands-on investigations and labs, and game-like activities that inspire and motivate scientific learning and curiosity.

Science Techbook is divided into units, and each unit is divided into concepts. Each concept has three sections: Wonder, Learn, and Share.

Units and Concepts Students begin to consider the connections across fields of science to understand, analyze, and describe real-world phenomena.

Wonder Students activate their curiosity and prior knowledge of a concept's essential ideas and begin making connections to a real-world situation.

Learn Students dive deeper into core scientific concepts through critical reading of texts and analysis of multimedia resources. Students also build their learning through investigations and interactives focused on the learning goals.

Share Students share what they are learning with their teacher and classmates using evidence they have gathered and analyzed during Learn. Students connect their learning with entrepreneurship, careers, and problem-solving skills.

Within this Student Edition, you will find QR codes and quick codes that take you and your student to a corresponding section of Science Techbook online.

We encourage you to support your student in using the print and online interactive materials in Science Techbook, on any device. Together, may you and your student enjoy a fantastic year of science and exploration.



Sincerely,

The Science Team

Table of Contents

Theme 1 | Systems

Theme 2 | Matter and Energy

Unit 2: Particles in Motion

Concept 2.1 Matter in the World around Us

Concept 2.2 Describing and Measuring Matter

Concept 2.3 Comparing Changes in Matter

Unit Wrap-Up

Theme 1 | Systems

Unit 1 Interactions of Organisms



Get Started

What I Already Know

Plants are all around us. As you walk to and from school, you can probably observe a variety of different plants. You probably know quite a bit about plants already. The first image shows a seed being planted. The last image shows plants on a windowsill. The image in the middle might give a clue as to why the plants on the windowsill are not surviving.







Write about what you know plants need to grow and survive, and make a recommendation on how to improve the growth or health of the plants in the window.

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Talk Together Have you ever planted seeds and observed their growth? Have you ever taken care of a plant in a garden or one inside your home or classroom? Share how you used your knowledge of plant needs to help the plants grow and thrive.

During this unit, you will learn that plants use specialized structures to convert light energy from the sun, air, and water to produce their own food. You will also learn about how different living organisms exist in an ecosystem in food chains and food webs, through interactions between producers, consumers, and decomposers. You will also learn how the energy from the sun flows through plants and animals. You will investigate what happens when a food chain is interrupted and what occurs when this happens in an ecosystem. Finally, you will bring together all that you learned and apply this knowledge to the unit project, Build a Miniature Ecosystem.

Food Chains and Food Webs

This is a squirrel eating food. What does it look like this squirrel is eating? Have you ever seen a squirrel? Like all living things, squirrel need energy to stay alive. Where does the energy that this animal needs come from? squirrel eat a variety of foods: leaves, fruit, insects, and even lizards. Larger animals eat squirrels to get their own energy needs. Can you think of other animals that eat for energy or organisms that provide energy to other living things?



Squrrel eating

What resources do plants need to grow and reproduce within an ecosystem?

How does energy move within an ecosystem? What can interrupt the flow of energy in an ecosystem?

Life Skills **I can apply an idea in a new way.**



Solve Problems Like a Scientist

Unit Project: Build a Miniature Ecosystem

In this project, you will use what you know about how living things interact with their environment to build a miniature ecosystem.



Producers in a Terrarium

Ask Questions About the Problem

Think about the different types of organisms that are found in a healthy ecosystem. Consider how they depend on the other living things in the community. What are some of the non-living things that are critical for survival in an ecosystem? Write some questions you can ask to learn more about ecosystems. As you learn about the components of a food web and the interactions that organisms have with their environment, record the answers to your questions.

CONCEPT 1.1

Plant Needs

Student Objectives

By the end of this concept:

- [ ] I can use evidence to argue that plants use specialized structures to obtain the materials that they need to grow from sun, air, and water.
- [ ] I can develop a model of how energy moves through plants.
- [ ] I can develop a model of plant processes that use natural resources to complete life processes.
- [ ] I can compare the structure and function of the vascular system in plants with the circulatory system in humans.

Photo Credit: dugdax / Shutterstock.com

Key Vocabulary

- [ ] arteries
- [ ] circulatory system
- [ ] digestive system
- [ ] seed dispersal
- [ ] germinate
- [ ] glucose
- [ ] nutrients
- [ ] phloem
- [ ] photosynthesis
- [ ] plant
- [ ] stem
- [ ] stomata
- [ ] survive
- [ ] system
- [ ] veins
- [ ] vessels
- [ ] xylem

Lesson 1



Activity 1

Can You Explain?



Have you ever planted a seed and watched it grow into a plant? Think about what the plant needs to grow. How do the structures of a plant use water, air, and light to perform life processes?

____

____

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Life Skills I can share ideas I am not yet sure about.

Activity 2

Ask Questions Like a Scientist

Tree Needs

You know that your body needs food and water every day to be healthy. What does a **plant** need to **survive**? How does it use resources to grow and thrive? Look at the photograph. Imagine what processes will happen after the tree is planted and it begins to grow from a seedling into a mature tree. Then, answer the questions that follow.

Preparing to Plant

When you plant a tree, you want it to grow to be strong and healthy. Write what this student needs to know about planting a tree in order for the tree to grow successfully.

____

____

____



Planting a Tree

My Model of a Plant

Draw a model of a plant and show how the plant meets its needs. Your model can use words, pictures, symbols, or any combination of these choices.



Activity 3

Evaluate Like a Scientist

What Do You Already Know About Plant Needs?

Plants and Animals

How similar and different are the needs of plants and animals? Think about what animals and plants need to live and grow. Then, answer the questions.

What do plants need to live and grow? ______________________________

How are the needs of plants similar to those of humans? ______________________________

How are the needs different? ______________________________

Plant Needs

Think about what plants need to live and grow. Label each item listed as "Basic Plant Need" or "Not Basic Plant Need."

Item	Basic Plant Need OR Not Basic Plant Need
Water	
Sugar	
Oxygen	
A forest	
Carbon dioxide	

Plants and Food

How do plants get their food?

____

How do the roots, stems, and leaves each help the plant get food?

____

Activity 4

Investigate Like a Scientist

Hands-On Investigation: Do Plants Need Soil?

You have discussed with classmates what plants need to grow. In this activity, you will test your ideas as you investigate whether plants need soil to grow. When a seed begins to grow, we say the seed is germinated. You will **germinate** seeds in wet paper towels, measure their growth, and then compare their growth to the growth of the seeds potted in soil.

Make a Prediction

Consider the claim: Plants can grow without soil. Do you agree or disagree? Record your ideas and make a prediction about what will happen when we compare how plants grow with and without soil. Be sure to include reasoning for your prediction.

My prediction and reasoning:



What materials do you need? (per group)

- Plastic cup, 250 mL
- Soil, potting
- Paper towels
- Seeds, fava or other beans
- Plastic zipper bags
- Water
- Pen or marker
- Metric ruler
- Lettuce or similar small plants (optional)

HANDS-ON INVESTIGATION

Life Skills **I can predict possible outcomes of an event.**

What Will You Do?

1. Use the water to wet the paper towel.
2. Place three seeds in the top half of the paper towel. Fold the bottom half of the towel up so that it covers the seeds. Place the paper towels inside the plastic zip bag and seal it.
3. Fill the plastic cup with potting soil. Plant the other three seeds in the soil. Water the seeds.
4. Label the bag and the cup with your name. Then, place the bag and the cup in a place where they can get sunlight.
5. Check the growth of seeds over the next several days. Dampen the paper towel and water the soil as needed.

Use the table provided to record your data. Measure the growth of each seed and record the measurements. Be sure to record the date of your observations and the location of the seeds, in the cup or the bag.

Seed Location: Towel or Cup	Measurement	Date	Other Observations

Think About the Activity

Now that you have tested your prediction, review the results by answering the following questions. Be sure to record important details for evidence and be complete in your reasoning.

How much did the seeds that were placed in the paper towels grow? How did they compare with the seeds planted in soil?

Did the growth of the seeds, both in soil and in paper towels, match your initial claim? If not, how was it different?

Based on your observations, do seeds need soil to grow? Can plants grow entirely without soil? If so, will they grow better in soil? Why?



Activity 5

Investigate Like a Scientist

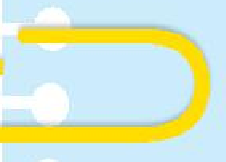
Hands-On Investigation: Sunlight: A Basic Need

In this investigation, you will test some of your ideas about plant growth. First, you will perform an experiment to look for any difference in how plants grow in the light and in the dark. Before you begin the investigation, read the text. Use what you learn to make predictions about the outcomes of your experiment. Once you have carried out the investigation, you will compare and contrast your observations with your classmates. You will set up the activity today and complete the activity later in this concept.

Trees and other plants make food through **photosynthesis**. Green plants use their leaves to collect sunlight and carbon dioxide from the air. Sunlight makes it possible for the water, taken in by the plant's roots, and carbon dioxide to combine. The result is sugar. This sugar gives the plant the energy it needs to grow. During photosynthesis, plants release oxygen into the air for us to breathe.







What materials do you need? (per group)

- 2 Plastic cups, 250 mL,
- Seeds, fava or other beans
- Soil
- Water
- Permanent marker, black



Make a Prediction



Develop a claim about what you think will happen to the plants.

What do you predict will happen to the plant in the light? and What do you predict will happen to the plant in the dark?

What Will You Do?

1. Use the permanent marker to write your name on the cups and label the cups A and B.
2. Add soil to your cups. Place the bean seeds on the soil, one per cup, and cover the seeds with about 2 centimeters of soil. Add the same amount of water to each cup to moisten the soil.
3. Place cup A where it will receive light and place cup B in the dark.
4. Use the table that follows to record data. Collect information about your plants over a period of 5–10 days that will help you determine how important the role of sunlight is in the growth of plants.
5. Record the date each time you make observations. Make sure you are consistent about what you are observing. For example, if you are measuring height, do it with both cups, every time.

Data Table for Plant Growth			
Date	Observations	Cup A (light)	Cup B (darkness)

After collecting data over several class periods, you will analyze your data. You should compare and contrast your observations with your classmates.

Think About the Activity

What are the basic needs of plants? ______________________________

What happened to the plant in the light? ______________________________

Explain why light is important to the plant growth. Include sketches to support your conclusions.

Life Skills **I can manage my time effectively.**

Activity 6

Observe Like a Scientist

Parts of a Plant

You investigated how different resources are important to plant survival. Now you will continue to research different plant parts that are involved in the process of turning resources into energy for the plant. Read the text. As you watch and read, add any new information to the diagram and descriptions you made in the previous activity.

Roots


Photo Credit: dugdax / Shutterstock.com

Even though all plants look different, they have similar parts. The roots of the plant perform some very important functions. Roots anchor the plant in the soil. They draw water and nutrients from the soil, which are needed to make food. Plant roots have hairlike features called root hairs. Root hairs increase the amount of water and nutrients the plant can take in. Nutrients pass from the soil to the root.

Stems

Nutrients are transported to the rest of the plant through the stem in the tubes called vessels. Stems give the plant support and come in a variety of forms. Tree trunks and shrubs have a wood stem. Most flowers have upright stems. Some stems climb, such as vines. Some stems, known as tubers, extend underground, such as the potato plant. Other stems, called runners, run along the ground and help to form new plants.

Leaves

There are many kinds of leaves. Some are narrow and look like needles, like those on pine trees. Other leaves are flat and much wider. All leaves have tubes running through them called xylem. Xylem helps carry water from the roots to the stem and leaves. The most important function of leaves is to make food for the plant.

Leaves need water, carbon dioxide, and sunlight to make food. This process of making food is called photosynthesis.

Structure and Function of Plant

A plant's roots absorb water from the soil and carry the water to the rest of the plant. Roots also carry **nutrients** from the soil to the plant. Water and nutrients move up a plant's **stem** through tubes called **vessels**. These vessels are also called **xylem**. Smaller vessels connect the stem to the leaves. This **system** helps feed and water all the parts of the plant. The air that plants need moves into leaves through tiny openings called **stomata**. Leaves also collect sunlight.

Photosynthesis

Photosynthesis is a process that takes place inside the leaves. Leaves contain chlorophyll, which gives them their green color. Chlorophyll captures energy from sunlight. Green leaves use the light energy from the sun to combine the carbon dioxide from the air with water to manufacture nutrients (such as sugars, starches, fats, and proteins) that the plant needs to live. Another set of tubes, **phloem**, transport the food materials downward, from the leaves to the other parts of the plant. In addition to producing food for the plant, photosynthesis also produces oxygen that animals and people need to breathe. Life on Earth without plants would be impossible.



Activity 7

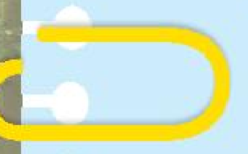
Investigate Like a Scientist

Hands-On Investigation: Up the Stem

You have researched the structure of plants. Now, are you ready to use what you have learned to test your ideas? In this investigation, you will observe how plants move water. You will investigate what transport vessels in a plant look like and how they work to help a plant stay alive.

Make a Prediction

Think about what you have learned from your research so far. Develop a claim about what you think will happen to the celery stalks when placed in the cup of colored water overnight.



What materials do you need? (per group)

- Celery stalk
- White carnation flowers (optional)
- Plastic cups, 250 mL
- Food coloring
- Scissors
- Hand lens
- Water



What Will You Do?

1. Select a stalk of celery. Examine the stem and any leaves closely. Record observations about how the stem looks in the "Before" section of the data table.
2. Fill a cup with water. Add food coloring to the cup of water. Snip about two centimeters off the bottom of the stalk and place it in the water.

3. Leave the stalk in the water cup and set aside where it will not be disturbed until the next day.
4. Observe the stalk. Record your observations.
5. Compare the actual outcome with your prediction.
6. Follow step-by-step directions given by the teacher to dissect the stalk.
7. Record detailed notes and drawings. Be sure to label the xylem.

Before	After
Comparison	

Think About the Activity

How did your predictions about the outcome of the investigation differ from your observations?

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Activity 8

Analyze Like a Scientist

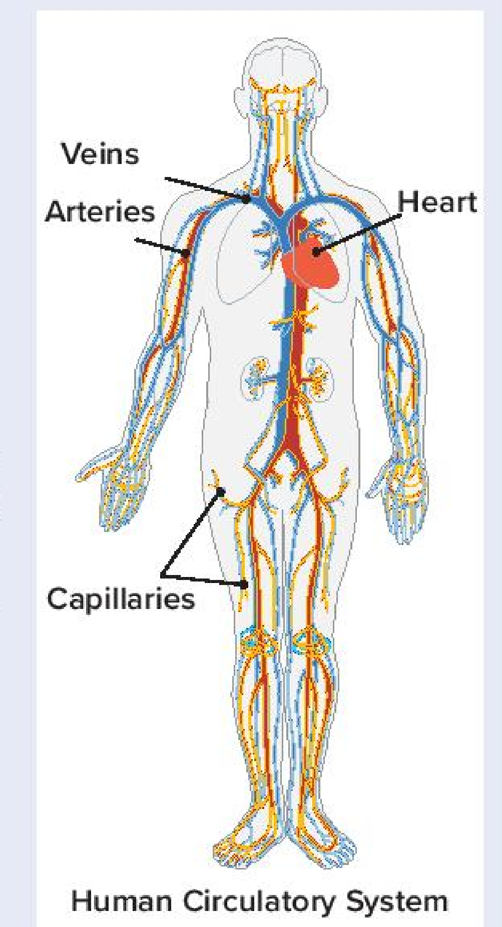
Comparing Plant and Human Systems

You have learned a lot about the structure and function of plants. Have you ever wondered how human systems might be similar to plant systems? Read the article to determine how the human **circulatory system** is like the plant's **vascular system**.

Comparing Plant and Human Systems

Need for Energy

Humans and plants both need energy and gases from the air to survive and grow. Plants can manufacture their own energy, **glucose**, through a process called photosynthesis. People, however, must eat food throughout the day for energy. Glucose and other nutrients enter our bodies through the **digestive system**. As we chew and swallow our food, nutrients are absorbed into the blood. Both plants and humans must take in gases from the air. Gases enter plants through the leaves. Air enters the human body through our mouth and nose and travels to the lungs, where oxygen is absorbed into circulating blood.



Human Circulatory System

The Human Body

The human body has a system that consists of the heart which consists of four chambers (two atria, two ventricles) and blood vessels (tubes) to transport nutrients and oxygen to the cells and organs. This is the circulatory system. The three different types of vessels in the human circulatory system are **arteries**, **veins** and **capillaries**.

Life Skills I can apply an idea in a new way.

Comparing Plant and Human Systems, *continued*

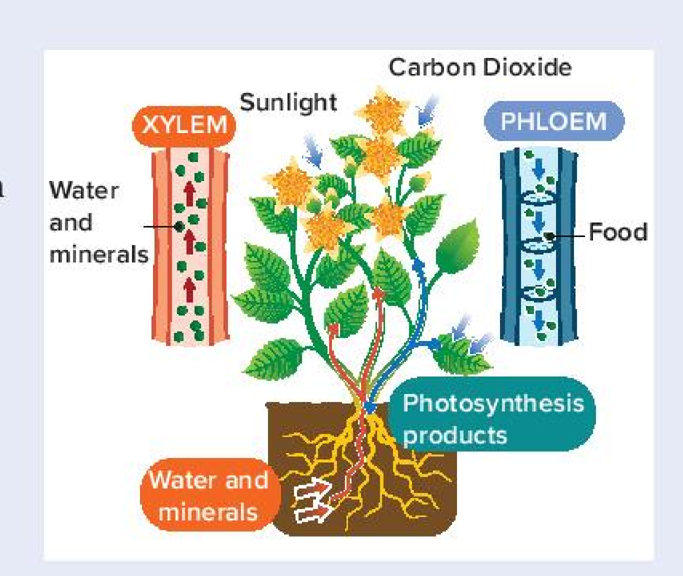
Blood moves in only one direction in a human's veins or arteries. Arteries carry blood that is rich with oxygen and glucose away from the heart to organs, muscles, bones, and cells so that the body can grow and heal. Veins return the blood that carries carbon dioxide and is low in nutrients and oxygen back to the heart for a recharge. You can probably see your veins and arteries through your skin on your hands or arms.

Comparing the Human Body to Plants

Like the human body, a plant needs energy and gases from the air to grow and heal. In plants, these life-sustaining substances move through a system of tubes and vessels called the vascular system. Similar to the way arteries and veins pump blood in a specific direction to and from the heart, plants have one-way vessels that move important substances between organs.

Transport System of Plants

Water and nutrients taken up by the roots must be transported to the leaves for food production to take place. Xylem tubes allow nutrient-rich water to travel upward through the plant. With the arrival of water, the leaves begin to manufacture glucose. Once energy production is complete, another set of tubes, the phloem, carries the glucose downward into other growing parts of the plant.



How is the transport system similar in plants and humans?



Talk Together What are some ways that you can keep your heart and the rest of your circulatory system healthy?



Activity 9

Analyze Like a Scientist

Plant Food

Plants are able to manufacture food from materials that they obtain from their environment. Read the text describing the process that converts energy from the sun into food. Number each step of the process in the paragraphs that follow. Then, compare and discuss your numbering with a partner. Once you and your partner agree, Create a table showing the steps, put in the table the steps number and description, then compare the results with your colleage.

Plant Food

You already learned that plants have structures that take in water and nutrients from the soil and move them to other parts of the plant. Plants also have structures that capture sunlight and take in air. Plants then combine the water with carbon dioxide to make a sugar called glucose. Plant cells use this glucose for food. This process happens in a plant's leaves. Sunlight provides the energy needed for this food-making process. Remember that energy can be transformed from one form to another. During this process, light energy absorbed from sunlight is transformed into chemical energy that is found in glucose. This process by which plants use sunlight to manufacture food within the leaf is called photosynthesis.

Glucose for Energy

Phloem moves glucose from the leaves to the other parts of the plants. Plant cells use glucose as a source of energy to live and grow. As they use glucose, they release oxygen and water into the air. These materials are considered waste products of the photosynthesis process. Other living things, such as animals, depend on the oxygen that plants release during this process of food production.

Life Skills I can be reflective.



Activity 10

Observe Like a Scientist

Flowers and Seeds

Plants use specific structures to obtain the materials they need to grow. You learned that the leaves play an important role in the process a plant uses to make its own food from those materials. What do you think the plant does with the food it makes? Read the text. Look for evidence of what plants do with the food they make.



When you think of flowers, you probably imagine large colorful plants seen in gardens. But some plants, such as grasses, have very small flowers that are hardly noticeable, and some flowers are not very colorful. Regardless of the shape, size, or color of flowers, they all have the same main job: to help plants reproduce. Plant reproduction is the process of making new plants. Flowers are the reproductive parts of many plants. Have you ever seen a sunflower? The small dark-colored objects in the center of the flower are seeds. If seeds receive air, water, and the correct temperature, they can grow into a new plant.



Talk Together Now, talk together about how plants use the food they make to reproduce. Why are flowers and seeds important to a plant?

Life Skills **I can predict possible outcomes of an event.**



Activity 11

Investigate Like a Scientist

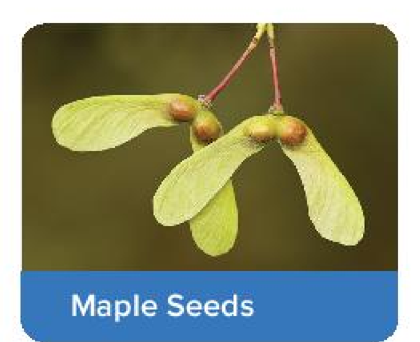
Hands-On Investigation: Seed Dispersal

You learned that plants have many structures to help obtain materials and create their own food. One way many plants use the energy from the food they make is in the production of seeds. In this activity, you will design and test a model of an imaginary seed to investigate how seeds are transported from place to place. This is called **seed dispersal**.

First, look at the seeds in the images that follow. What are some of the properties that you notice? Then, listen as your teacher describes the different ways seeds travel. Decide how you think the seeds in the images move from place to place.



Coconut



Maple Seeds



Tomato Seeds



Burdock Seeds



Apple Seeds



Dandelion Seeds

Make a Prediction

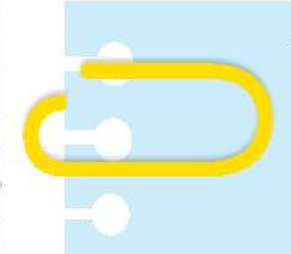
You are going to model one way that a seed can effectively be transported from one place to another. Write or draw your predictions.

Life Skills **I can apply an idea in a new way.**

Which method of dispersal do you think is highly effective at moving seeds from one place to another?

How will you make dispersal for your model seed possible? Draw what your model seed will look like in the space provided.





What materials do you need? (per group)

- Paper
- Pencils
- Pan of water
- Sample seeds or images of seeds
- Fan or access to an outside area
- Piece of carpet or fuzzy blanket
- A variety of model-building materials



What Will You Do?

As you complete the following steps, record your observations in the table provided.

Part 1: Traveling Seeds

1. Observe a variety of different types of seeds. Think about the structures that help these seeds travel using either water, wind, or animal transport.
2. Decide with your team which method of seed travel you would like to investigate—water, wind, or animal transport, and review the materials available to create your seed model, and drow sketch for it.

3. Present and discuss your sketch with your team. With your team, choose one design to build, and build your seed model with your team.
4. Test your model using either the pan of water, an area with moving air, or the piece of carpet or fuzzy blanket (representing animal fur). Record the results of your test.

Part 2: Organize Data

5. With your group, evaluate your model and discuss how successful it was.
6. Share your model and results with the rest of the class.
7. As a class, discuss which models and travel methods were most effective.

Record your results in the table provided.

Notes: Which method is your model seed designed for?	Observations: What happened?

Think About the Activity

What parts of your model seed aid in dispersal?

What kinds of seeds do you think are the most easily transported? Why?

Did your model function as you predicted it would? Explain.

How could you improve your model or test?



Activity 12

Record Evidence Like a Scientist

Tree Needs

Now that you have learned about plant needs, look again at the image Planting a Tree. You first saw this in Wonder.

How can you describe Planting a Tree now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

How do the structures of a plant use water, air, and light to perform life processes?

Now, you will use your new ideas about plant needs to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, what can you conclude? It should not start with *yes* or *no*. My claim:

Next, record the evidence that supports your claim. Evidence can come from videos, readings, interactives, and Hands-On Investigations. Evidence:

Now, write your scientific explanation and include your reasoning. Scientific explanation with reasoning:

Life Skills **I can apply an idea in a new way.**

CONCEPT 1.2

Energy Flow in Ecosystems

Student Objectives

By the end of this concept:

- [ ] I can develop a model to show how energy moves through an ecosystem.
- [ ] I can create a model to explain the different roles that organisms play in an ecosystem.
- [ ] I can explain how the health of each type of organism in an ecosystem impacts the overall health of the community.

Key Vocabulary

- [ ] consumers
- [ ] cycle
- [ ] decomposers
- [ ] ecosystem
- [ ] food chain
- [ ] food web
- [ ] interact
- [ ] predators
- [ ] prey
- [ ] producers
- [ ] scavengers

Photo Credit: Zdenek Matyas Photography / Shutterstock.com

Lesson 1



Activity 1

Can You Explain?



Photo Credit: (a) Zdenek Macha Photography / Shutterstock.com; (b) Henk Martin / Shutterstock.com

You probably know a lot about ecosystems already. An **ecosystem** consists of organisms and their environment, and includes both living organisms and non-living things. Plants, animals, and even humans are all part of an ecosystem. How does energy flow through an ecosystem? Look at the image and record what you already know about energy in ecosystems.

How does energy flow through an ecosystem?

____

____

____

____



Life Skills **I can share ideas I am not yet sure about.**

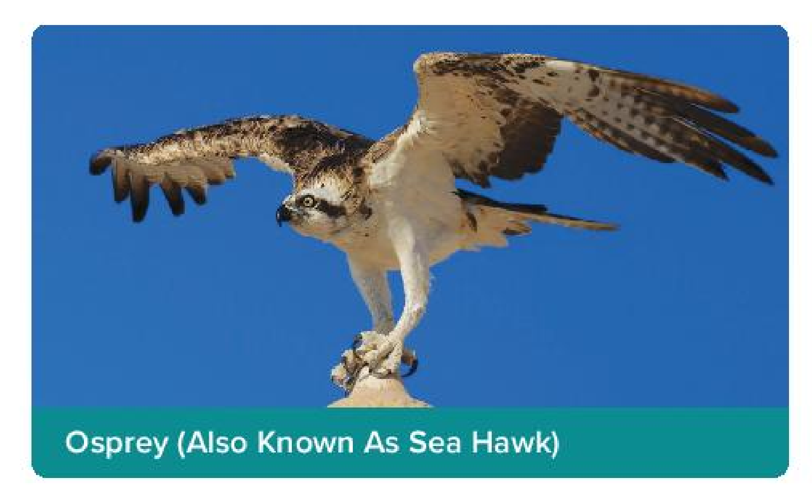


Activity 2

Ask Questions Like a Scientist

How Hawks Get Energy?

Have you ever seen a hawk? Imagine what a hawk must do to survive. Look at the photograph. Then, answer the questions that follow. Record your answers in the space provided.



Osprey (Also Known As Sea Hawk)

Think about what you have seen or read about hawks. What do you wonder about how a hawk gets energy in its environment?

I wonder . . .

Draw a model of how a hawk interacts with the environment. You can use words, images, and symbols.



Activity 3
Evaluate Like a Scientist

What Do You Already Know About Energy Flow in Ecosystems?

In the previous activities, you began thinking about how plants and animals get energy. Now you will summarize your ideas before delving deeper into how energy flows in ecosystems. Think about the needs of plants and animals. Answer each question in the space provided.

What Do Living Organisms Eat?

Join the living organism with its food.

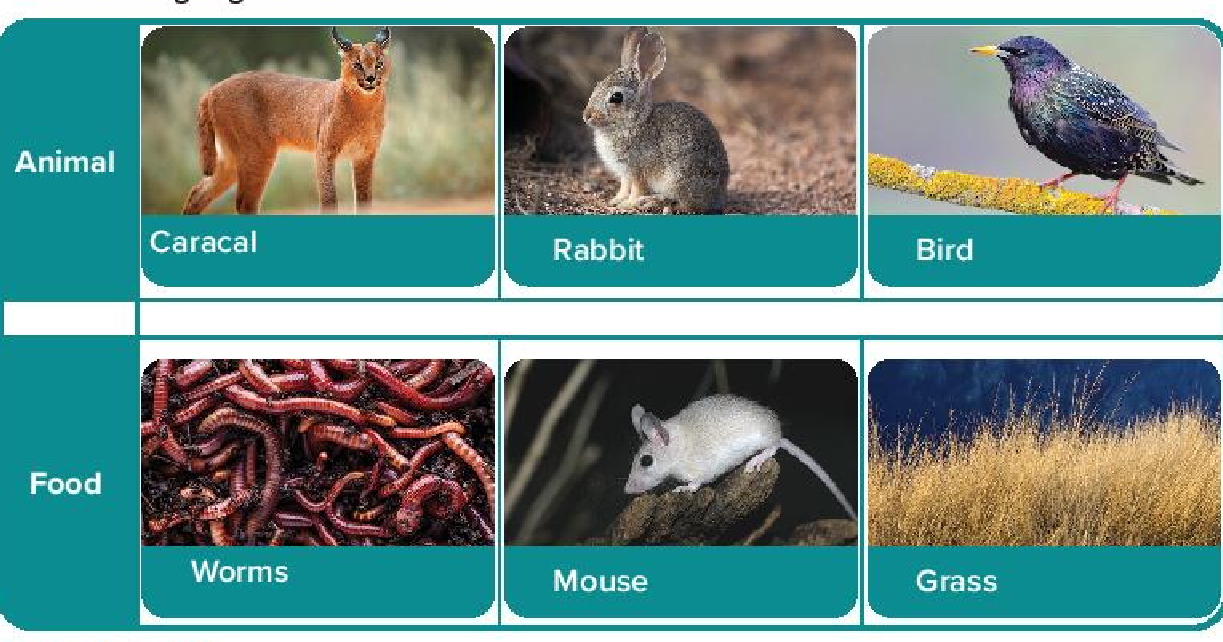


Photo Credit: Zdenek Matyas Photography / Shutterstock.com
Photo Credit: Zdenek Matyas Photography / Shutterstock.com

Ecosystems

Read each question. Then, write your answers in the spaces provided.

What is an ecosystem? and What are some examples of ecosystems?

What is the relationship between sunlight and the energy we get from our food?



Activity 4

Analyze Like a Scientist

Food Is Energy

Think back to your early ideas about how to answer the Can You Explain? question or any questions you had during Wonder. Next, read the text. Circle evidence that supports your early ideas. If information goes against your early ideas, underline the information.

Food Is Energy

How Do We Get Energy?

How do you get the energy you need to think, breathe, move, or do anything else? Some activities, such as hard work or exercise, require a lot of energy. Your body still uses some energy even when you sleep. Food and the oxygen we breathe provide the energy we need throughout the day.



Children Running

The Primary Source of Energy

All living things need energy to live, grow, and carry out life processes. The primary source of energy for all organisms on Earth is the sun. Plants absorb sunlight through their leaves and use the sun's energy to make their own food. Sunlight provides the energy for plants to convert water and carbon dioxide from the air into glucose. Glucose is the sugar that plants use to sustain life. This process, known as photosynthesis, is fundamental to life on Earth.

Energy from the Environment

Living organisms can either produce their own food or get food from other organisms. Animals, including humans, cannot make their own food. Instead, animals get energy from the environment in which they live. Some animals eat plants as food. Some eat other animals that eat plants. Some eat both plants and animals. In this way, energy produced from the sun passes through all life on Earth.



Activity 5

Observe Like a Scientist

Food Chains

You already know that energy is the key to keeping organisms alive. How does energy move through an ecosystem? Read the text. Write down any questions or important facts that you would like to share later. Be ready to discuss with your group.

Energy for Life

All organisms need energy to live. While some living things can produce their own food, but the most cannot. This means that most organisms need to eat to get the energy they need to survive. Living organisms feed on one another. In an ecosystem energy is passed on through food chains of organisms.

Producers

The first link in any **food chain** is the food **producers**. Plants use energy from the sun to produce food. Producers are able to produce food in the form of energy-rich glucose. Nearly all of the producers on Earth are plants.

Consumers

The second link in a food chain is the primary **consumers**. These are animals that eat plants. In this way, energy begins to move up the food chain. Many insects are primary consumers.

Next are the secondary consumers that eat the primary consumers. Birds are secondary consumers because they eat insects and other organisms that live on a diet of plants.

The next level of consumers is the tertiary consumers that eat the secondary consumers. Tertiary consumers are often large meat-eating animals, like alligators.

Decomposers

The final link in the food chain is the **decomposers**. Fungi and bacteria are two examples of decomposers. Decomposers recycle nutrients back into the ecosystem through the process of decomposition. Animals such as worms and millipedes eat dead matter. The waste they produce is rich in nutrients. This makes the soil fertile for plant growth.



Activity 6

Analyze Like a Scientist

Energy Flow

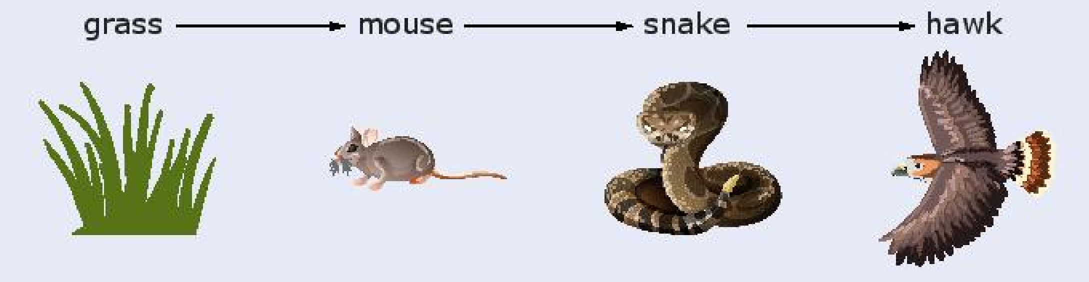
Let's gather more information to understand food chains. Read the text. Underline evidence that you could use to investigate what would happen if an organism was removed. Record the evidence in the space provided.

All Organisms Need Energy

Organisms that do not capture energy directly from the sun need other organisms to obtain energy. Food chains show how energy passes from one organism to another in an ecosystem. The food chain shows the food, or energy, relationships among organisms within specific ecosystems.

One Example of a Food Chain

Grass makes its own food using energy from sunlight. A mouse eats the grass to get energy. A snake then eats the mouse, and a hawk then eats the snake. The energy from the sun passes to the grass, then to the mouse and snake, and finally to the hawk. Unlike grass, animals like the mouse, snake, and hawk cannot make their own food from sunlight. The following food chain shows the relationship among these organisms.



Predator and Prey

In this food chain, the hawk and the snake are **predators**. They also hunt other animals as **prey**. The snake and the mouse are prey. They are hunted by other animals for food. Both predators and prey pass food and energy through the food chain.



Activity 7

Evaluate Like a Scientist

Food Chain

You have seen and read about some examples of food chains. Now, let's make a model of a food chain. Write the names of the organisms in the correct boxes to make a food chain.

bird	grass	grasshopper
hawk	snake	

How would you add a grass-eating beetle that the bird eats to this model?

Life Skills **I can make careful decisions.**

Activity 8

Analyze Like a Scientist

Food Webs

You learned that a food chain shows feeding relationships between organisms. Most organisms are a part of several food chains. Read the text. Think about how the organisms you observed or read about in this concept **interact** with one another. Then, write the names of the organisms in the correct column of the table.

Interactions Among Organisms

Think about the different foods you eat. Imagine those foods are connected to you by lines in a web. All living organisms, including you, interact in food webs. We can draw these webs to show how organisms are connected within ecosystems.

Interconnected Food Chains

A **food web** is made up of several interconnected food chains. Food chains show the relationship of food and energy that passes from one organism to another. All food chains begin with an energy source, like the sun. The sun provides energy for the producers. Plants are producers. Plants provide food for a series of consumers, which may eat only plants or may eat both plants and animals. Consumers who eat other animals are predators and the animals they eat are the prey. The ways in which many food chains intersect within an ecosystem form a food web.


A Hawk with Prey

Producers	Predators	Prey



Activity 9

Evaluate Like a Scientist

Interactions in Food Webs

You have now learned a lot about food webs. Using what you know and have observed, answer the three questions that follow to help you communicate your ideas about food webs.

How do food webs model interactions among organisms in an ecosystem?

How does a food web represent a system for the transfer of energy?

Why is a food web a better choice to use to show interactions among organisms than food chains?

Now, draw a diagram of your own food web for an ecosystem of your choosing. Be sure to include at least five different organisms in your food web.



Activity 10

Record Evidence Like a Scientist

How Hawks Get Energy?

Now that you have learned about how energy moves through an ecosystem, look again at this image. You first saw this in Wonder.

How can you describe How Hawks Get Energy now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

How does energy flow through an ecosystem?



Now you will use your new ideas about how energy moves through an ecosystem to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, What can you conclude? It should not start with *yes* or *no*. My claim:

Next, record the evidence that supports your claim. Evidence can come from videos, readings, interactives, and Hands-On Investigations. Evidence:

Now, write your scientific explanation and include your reasoning.

Scientific explanation with reasoning:

Life Skills **I can apply an idea in a new way.**





Activity 11

Analyze Like a Scientist

Careers in Ecology: Plant-Community Ecologist

Read the text. Then, discuss the questions.



We might think of somebody wearing a white lab coat and standing inside in a lab. But Dr. Barak gets to do her research out on the prairie. She always loved animals and plants growing up, but she did not know that there was an actual science where you could study animals and plants she learned about ecology. She took a class in restoration ecology and that was where she learned about, rebuilding habitats that are damaged.

Seed Dispersal

An interesting thing Dr. Barak has learned about plants is that different plants need different ways to transport or disperse their seeds. One plant has seeds that are really sticky. Their seeds can stick to your clothing. You never know where you might leave them. Other plants have seeds that are dispersed by the wind. These seeds are released from the plant when the plant is ready. The seeds fly away to new habitats to grow in other places.

Careers in Ecology

When a human encourages to spend some time observing the natural world. If you are interested in the natural world, consider participating in conservation or restoration work in your area to help take care of plants and animals. Your interest in nature now could lead to a career in ecology later in the future.

Talk Together Think about the task of scientist when he make rebuilding habitats that are damaged when planting plants single or in groups and how does this affects its growth and its stability

Life Skills **I can predict possible outcomes of an event.**

CONCEPT 1.3

Changes in Food Webs

Student Objectives

By the end of this concept:

- [ ] I can demonstrate through modeling how changes in an ecosystem can disrupt a food web.
- [ ] I can construct an explanation about how human activity can negatively impact an ecosystem.
- [ ] I can argue for possible solutions to environmental problems that can restore the health of an ecosystem.

Key Vocabulary

- [ ] climate
- [ ] conservation
- [ ] habitat
- [ ] microorganisms
- [ ] microplastics
- [ ] nursery
- [ ] pollution
- [ ] population
- [ ] restoration



Activity 1

Can You Explain?



Look at the image of the dried lake or river. Is this a healthy ecosystem? Think about what you already know about ecosystems and food webs.

What might happen to a food web when an organism or the environment changes within an ecosystem?



Life Skills **I can share ideas I am not yet sure about.**

Activity 2

Ask Questions Like a Scientist

Protecting Ecosystems

As you read the text, think about what you know regarding the protection of water ecosystems from **pollution** or other human activity.

Palau is an island that uses various **conservation** programs to protect the marine environment and its resources. On an island, it is impossible to separate what happens on land from what happens in the marine environment. Therefore, Palau must closely manage land activities in order to control the quality of the marine environment.



Palau also needs well-designed, protected marine environments in place. One way to create these protected environments is to work with fishers to make sure they are not overfishing the coral reefs.

Have you ever been to the beach or swum in an ocean? Think about what can be done to protect ecosystems. Write what you wonder about protecting ecosystems.

I wonder . . .

I wonder . . .

Life Skills **I can predict possible outcomes of an event.**



Activity 3

Evaluate Like a Scientist

What Do You Already Know About How Food Webs Can Change?

If . . . Then

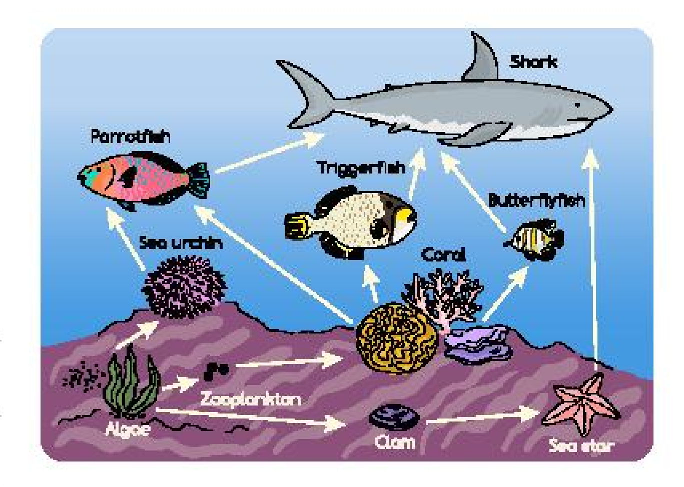
We know that sometimes ecosystems change. Does that mean food webs can change too? Think about what might affect an ecosystem and possibly a food web. Read each statement in the first column. Finish each statement in the next column with what might happen next. Write why you think these results might occur. Continue until you have completed each statement.

If	Then
If there is a gentle rain in the desert,	then the desert ecosystem might ______ because ______.
If there is a heavy rain in the desert,	then the desert ecosystem might ______ because ______.
If there is a drought and all the grass dies,	then the food web in the ecosystem might ______ because ______.
If there are many top predators in the food web,	then the organisms in the food web might ______ because ______.

What might happen to a food web when an organism or the environment changes within an ecosystem?

Food Webs

Look at the image of a marine food web. Think about how the food web works. Describe which organisms eat other organisms, in the food web.



My Ecosystem

You have already thought about food chains and food webs. Now think about an ecosystem in your own area. Tell the story of your own ecosystem through a four-panel drawing. Show how energy flows from the sun, to producers, all the way to decomposition.

Be sure to label producers, consumers, and decomposers in your drawings.

Life Skills **I can apply an idea in a new way.**



Activity 4

Investigate Like a Scientist

Hands-On Investigation: Energy Flow Body Model

Flow of Energy

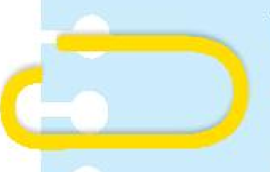
In this activity, you will model the flow of energy through a food web. As you model the process, keep in mind how energy is used.

Make a Prediction

How can we use the materials provided to model energy flow in an ecosystem?

What Will You Do?

1. Your teacher will assign you a role to play from a picture of a food web. You will interact with the other "organisms" in your class according to the role you play (producers, consumers, decomposers, predator, prey).
2. Use your paper squares to represent energy.
3. Play a game of predator-prey tag, in which you capture or lose your energy (represented by paper squares).
4. Think about what this game reveals about the flow of energy in the ecosystem. Use what you learned while participating in the modeling activity to answer the questions that follow.



What materials do you need? (per group)

- Index cards labeled with organisms
- Picture of a food web
- Paper squares, 3 cm x 3 cm, 10 per student



Think About the Activity

What is happening to the energy in this system?

Where in this system are energy changes occurring?

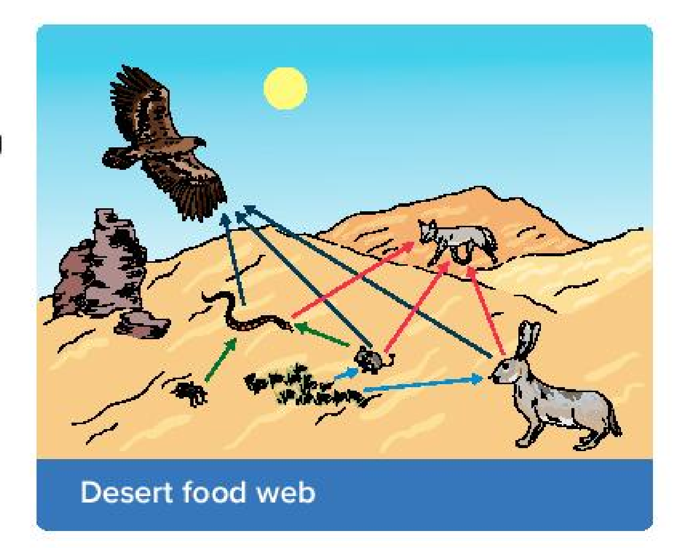


Activity 5

Observe Like a Scientist

Desert Food Web

A food web shows many different feeding relationships among organisms in an ecosystem. Recall that the arrows show the direction that energy flows. Look at the image of the desert food web. Then, answer the questions that follow.



Desert food web

Photo Credit: Koen Adriaenssen / Shutterstock.com

What would happen to the hare if all the grass were removed from the area?

What would happen to the eagle if all the grass were removed from the area?

How does energy travel from the grass to the eagle?

Life Skills **I can predict possible outcomes of an event.**



Activity 6

Observe Like a Scientist

Population Changes

Does one species in an ecosystem affect the **population** of another species? Explore population changes in an ecosystem. Read the text. Then, answer the questions.



Seabirds nest on top of mountain cliffs. They dive deep down into the sea to feed on small fish. The fish feed on **microorganisms** floating on the surface of the sea. These fish are the main source of food for many seabirds. Microorganisms can make their own food.

They are found in cold water habitats. These microorganisms are the producers in the marine food web. Small fish feed on these microorganisms. The microorganisms need cold water to survive. If the **climate** changes and the water becomes warm, they will move toward an area where the water is cooler. The small fish that feed on microorganisms will also move to a new **habitat**. The seabirds will then no longer have a food source. Some will find a new habitat, while others will die.

What does the phrase *population change* mean?

____

How can change in the climate affect the population of a species?

____

Why does change in the population of one species affect the population of other species?

____



Activity 7

Analyze Like a Scientist

Habitat Loss

Think about what you have learned about ocean food webs. Read the text and compare the images. Then, answer the questions.

Habitats provide organisms with all the things they need to survive. Humans change habitats. They do this when they add buildings and roads. They do this when they add substances to the water or overfish in the ocean. Human activity can also impact the weather and nonliving factors in an ecosystem, such as the temperature of ocean water. All of these changes can cause habitat loss. Habitat loss is one of the main causes of extinction.


Healthy Coral Reef

Photo Credit: Koen Adriaenssen / Shutterstock.com

Coral Reefs

Coral reefs are some of the most diverse and valuable ecosystems on Earth. Coral reefs support large numbers of species, including fish, other corals, and a variety of other sea life. Coral reefs are important habitats for living organisms. Coral reefs are also important for tourism. People travel to coral reefs for fishing or diving, providing local hotels, restaurants, and other businesses with visitors and income.

Coral Bleaching

Coral bleaching happens when water temperatures rise. When water is too warm, corals will get rid of the algae living in their tissues. This causes the coral to turn completely white. Bleaching events stress corals and often they do not survive.

Why are healthy habitats important to all organisms in a food web?

____

How might the loss of a coral reef change the ocean or the sea food web?

____



Activity 8

Analyze Like a Scientist

Plastic Pollution

Read the text to learn about the effect of plastics in the marine environment. Discuss what you learned with your class. Then, answer the questions.



Large amounts of plastic are thrown in the marine environment every year. Most of it comes from land, plastics affect marine life. Whales, turtles, seabirds, and fish cannot often tell the difference between real food and plastic. For example, a sea turtle cannot see the difference between a jellyfish and a piece of plastic in the water. So, sea turtles eat a lot of plastic thinking that it is jellyfish. Plastic is not nutritious. It can also be toxic and sharp, so it is really bad for animals.

Plastic products get broken down into smaller pieces. Some pieces are even smaller than a grain of rice. We call them **microplastics**. Coral filters the seawater to get its food. When coral does this, it also ingests the microplastics that are as small as the pieces of food that it is getting from the water.

What do you think might happen if the amount of plastic in the marine environment continues to rise?

What is something you could do to help reduce the amount of plastic that ends up in the marine environment?

Life Skills **I can predict possible outcomes of an event.**

Activity 9

Record Evidence Like a Scientist

Protecting Ecosystems

Now that you have learned about changes in food webs, read the text about Palau's marine environment. You first saw this in Wonder.

How can you describe Protecting Ecosystems now?

____

____

How is your explanation different from before?

____

____

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

What might happen to a food web when an organism or the environment changes within an ecosystem?

Now you will use your new ideas about changes in food webs to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, What can you conclude? It should not start with *yes* or *no*.

My claim:

Next, record the evidence that supports your claim. Evidence can come from videos, readings, interactives, and Hands-On Investigations.

Evidence:

Now, write your scientific explanation and include your reasoning.

Scientific explanation with reasoning:

Life Skills **I can be reflective**



Activity 10

Analyze Like a Scientist

Habitat Restoration

Read the text, then complete the next activity.



Photo Credit: Koen Adriaenssen / Shutterstock.com

Human activity can cause major changes to the environment. Riverbanks erode when too many plants are removed. Floods may reach farther inland when wetlands are drained. Once harm has been done to the environment, scientists, engineers, and concerned citizens work on **restoration**. This involves restoring the land and water back to how it was before harm was done. Restoration projects try to repair all parts of the habitat. They try to bring back food and water sources. They also look to recover shelter and space. Most projects are a lot of work and take a long time, but they can have very positive results.

Protecting and Rebuilding Coral Reefs

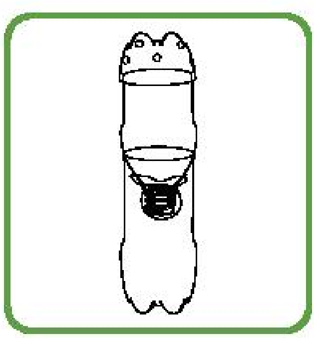
One example of restoring a habitat is a coral reef rehabilitation project happening in the Arabian Gulf. Scientists are harvesting small fragments of various coral species and they are moving them to a **nursery**. The nursery is an area in the ocean where the small pieces of coral are nurtured until they can be moved back to the reefs where they were dying. The healthy coral can then continue growing and reproducing to make a thriving reef again. These scientists in the Arabian Gulf also conduct research and study the best coral species to use for future restoration projects. Coastal communities near the reefs have adopted a "zero plastics" way of life in Egypt. By limiting single-use plastics on land.

Construct an argument for why habitat restoration projects and changes in human behavior both are important. Use your understanding of ecosystem changes to support your argument. Then, suggest one way people in your community can help prevent damage to the environment.



Solve Problems Like a Scientist

Unit Project: Build a Miniature Ecosystem



You have learned a lot about ecosystems. Today, you will begin building a miniature ecosystem. It will be a very small ecosystem, so small that it will fit inside two plastic bottles. Work with your team to consider what you could create in such a small space. Once your teacher has given you materials, build your miniature ecosystem. When it is complete, create a model of the transfer of energy.

My Miniature Ecosystem

Make a detailed drawing of your miniature ecosystem. Use the labels *producer*, *consumer*, and *decomposer* to identify the different types of organisms in your project.

Modeling the Flow of Energy

After you have built your ecosystem, think about how energy flows through this ecosystem. Create two diagrams to model this transfer of energy. Your diagrams should account for all the energy that enters your ecosystem. If you do not have consumers or decomposers in your bottles, consider what kinds of organisms could be added to complete your models. Include those organisms in your drawings as well.

Terrarium	Aquarium

Understanding Relationships

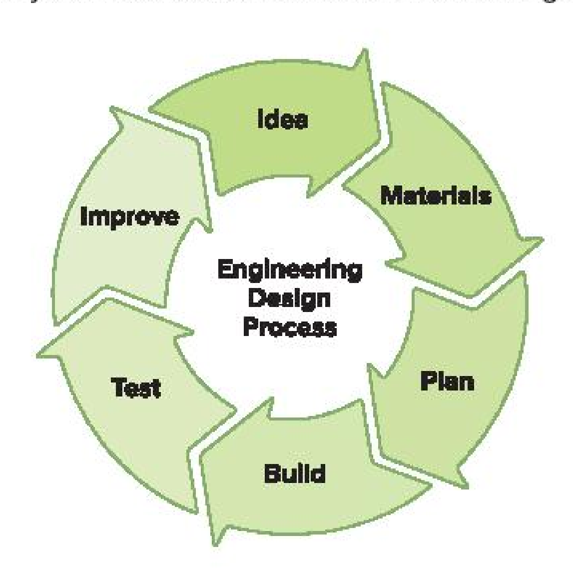
Explain how the diagrams represent energy flow in your miniature ecosystem. Predict what would happen if one of the organisms was removed from the ecosystem.

Life Skills **I can apply an idea in a new way.**



Interdisciplinary Project: Waste Not, Want Not

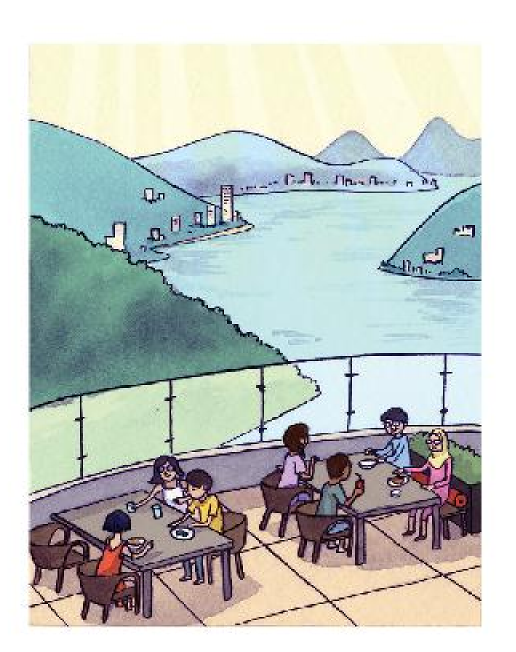
In this interdisciplinary project, you will use your science and math skills to find a solution to a real-world problem. First, you will read a story about a fictional group of characters, called the STEM Solution Seekers. Then, you will study some background information, and you will design, test, and refine a solution to the overall challenge. You will go through the steps of the Engineering Design Process, as shown in the diagram. You will also do some additional work in your math class related to this challenge.



The project Waste Not, Want Not challenges you to think about the problem of plastic pollution, especially in waterways. In the story, you will read about a problem that the STEM Solution Seekers observe while walking along a body of water that has been polluted with plastic trash. You will consider ways to reduce the amount of plastic that becomes trash, as well as design and build a product using repurposed plastic.

Waste Not, Want Not

Friends Seif, Aya, Nour, and Menna are in Seif's hometown while the projects are being judged. "What is all that stuff floating in the water, Seif?" asks Nour. "Is it some kind of seaweed?" Aya says, "It does not look like seaweed to me. It looks like plastic! Look at all the different colors."

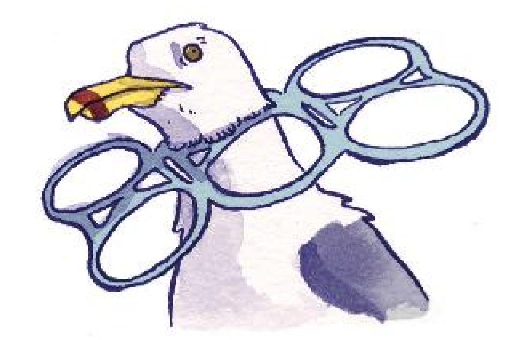


"It probably is plastic and other kinds of trash," Seif replies. "We have a big, big, big problem with trash washing up on the shores.

Aya, who has been quiet, adds, "I have heard that this happens in other places of the world too especially down near the ocean. Some of the fish eat the plastic because it looks like food. Other sea creatures get tangled up in the trash."

"Oh, I have heard about that," says Nour. "I believe the Pacific Ocean is full of plastic. It kills all kinds of marine life."

Seif gets excited, "Yes! There is plastic from all over the world in the ocean. I heard about a huge island of plastic in the middle of the Pacific Ocean!"



"Did you see the group who presented the trash-eating sea drain at the science fair?" asks Aya.

"Such an amazing idea." Menna exclaims. "I would like to see that on the Mediterranean Sea.

Nour considers, "That drain was really great, but I am not sure it is enough to get rid of everything. Also, it only works on stuff that is already in the water. I think people need to do more to keep trash from getting into the ocean in the first place."

"Are you talking about recycling, Nour?" Aya asks.

Nour has just taken a very big bite of a cookie, so Seif jumps in. "Not just recycling, but also reusing and repurposing and reducing. We produce tons and tons of trash every day. We need to find ways to cut down on what we use and throw away. Too

much of it ends up on the streets and in the water." As he finishes, Seif is nearly standing up and his arms are in the air.

"Calm down, Seif," Nour says with a smile. "And, yes, I meant all of those things."

Menna says, thoughtfully, "I do not think plastic decomposes like other materials do. I wonder if there are ways to reuse some of that plastic."

"Plastic is here forever," Aya says, reaching for another cookie. "Water bottles and food containers are the worst, I think. But surely we do not need to use a new plastic bottle every time we want more water."

"Could you melt down the plastic and make other things with it?" Menna wonders.

"Yes," Nour says, "but that is not the only answer to the problem. We also need to find ways to produce less plastic to begin with. Maybe use paper and wood instead."

Aya says. "I do not think more paper and wood will help. But maybe we could use less and turn the plastic into something else, like . . . building materials?"

Seif says, "There are lots of kinds of plastic and lots of kinds of other trash. There must be more ways to recycle and reuse."

The team agrees and begins to make a list of how they might recycle, reuse, and reduce trash.



How Bad Is Plastic Pollution?

How did you use plastic today? People use plastic for everything from food storage to medical devices. However, much of the plastic we use ends up getting thrown away. Plastic bags and water bottles are items that often get tossed into the environment. Plastic, as one form of discarded waste, is especially dangerous to animals. Animals can get tangled in plastic rings or suffocate from eating plastic parts.

Minimizing the Impact of plastic pollution

Plastic is a common material that we use to package our food, help us transport water, and build structures. We know that we will always use plastic in some form in our lives. This is why humans are considering ways to minimize the impact of plastic on the environment in other ways.

Photo Credit: Mohamed Waled Bustani / Shutterstock.com



Earlier in this concept, you learned about areas in Egypt that have banned single-use plastic. In many places, conservation groups organize volunteers in beach and river cleanups. Volunteers and other people collect plastic trash along the shore. Some people think of ways to reuse their plastic items and containers so that they do not get thrown out to start with. How could you reuse a plastic item in your home and turn it into something you could use again? What other problems could you help solve with your repurposed plastic item?

Many Egyptians advocate for people to recycle more of their plastic to help this problem



Hands-On Investigation

Engineering Your Solution

Challenge

Your challenge is to design and build something new that you and your teammates can make with plastic bags or bottles. You may also want to incorporate other recyclable materials—just ask your teacher. Consider creating something that you need and that will help you solve a problem or complete a task.



Water Bottle Bird Feeder

Photo Credit: Mohamed Waled Bustani / Shutterstock.com

Objectives

In this activity, you will . . .

- Sketch a prototype for your repurposed plastic design.
- Create your design and list the materials your group uses.
- Describe any problems you encounter and explain how you solve them.

What materials do you need? (per group)

- Plastic bottles or plastic bags
- Pencils
- Building materials, such as tape, glue, string, or construction paper
- Digital camera or digital video camera (optional)



Procedure

1. **Review the Challenge** Study the challenge and design requirements for this project.

Life Skills **I can choose the best solution of a problem**

2. **Assign Group Roles** Decide the roles for the members of your group and record the names next to each role.
3. **Sketch Ideas** Review the materials available with your teammates and begin brainstorming. Each team member should make their own sketch. Review your sketches as a group and decide on one design to fully develop. Add more details to make it your blueprint that you will use to help you create your solution.
4. **Plan and Build** With your teammates, gather materials and begin building your repurposed plastic item. Make sure to keep track of your steps and process. Follow your group roles and work together. As you build, you will likely run into problems or challenges that you did not anticipate. Keep going. Solve one problem at a time, using your group's creativity to come up with solutions. Try multiple solutions to see what works best.
5. **Reflect and Present** Once your project is finished, reflect on your process and final product. Complete the Analysis and Conclusions section of your student investigation sheet. Identify ways you could improve. Prepare to share with your class.

Group Roles

Roles	Student name
Team Captain Provide encouragement and support. Help other team members with their roles if needed. Keep track of timeline.	
Materials Manager Gather and organize materials. Request additional materials if needed. Adjust materials as needed (cut, size, fold, and so on).	
Engineer Coordinate building the model. Suggest when a test may be needed. Make sure the team is building safely.	
Reporter Record all steps of the process. Share the process the team went through to complete the challenge.	

Design Requirements

- [ ] Your design turns a plastic bottle or plastic bag into something new.
- [ ] Your team's final sketch lists the materials needed and how the design will work.
- [ ] Your group collaborates to use your materials listed to create a repurposed plastic product.

Sketching Our Design

Sketch your initial idea for how your team can repurpose your plastic bag or plastic water bottle into something new that others could use. After you and your teammates share your ideas, vote on one final design to create, and label the materials needed. Add a sentence to the bottom of your sketch describing how your prototype will work.

With your team, discuss these two questions about your ideas:

- What do you like about these ideas?
- Where can you make improvements to the design?

Circle the final design that you will create.

Optional Extension

Develop a slogan for your new repurposed product that will teach others about what it does and why they would want to buy it. Include this slogan, with a sketch of your final product, on a poster to advertise your new design. If you have a digital video recorder, create and film a commercial to go along with your poster. Make sure to explain how your new design works and what materials it is made out of.

Analysis and Conclusions

How does your design turn a plastic bottle or bag into something new? What materials did you use?

What problems did you encounter as you built your repurposed product? List two problems and how you solved them.

Problem 1:

Problem 2:

Assess your learning

Choose the correct answer from the following

1. .... the main source of energy for all organisms.
   a- Food b- Water
   c - The sun d - The moon

2. .... absorbs the sunlight that the plant needs to make food.
   a- Roots b- Leaves
   c - Wood vessels d - Stem

3. All of the following are considered productive organisms except ....
   a- grass b- hawk
   c- seeds d- the fruit

4. ....can make her own food.
   a- Plants b- Humans
   c - Animals d- Plants and some animals

5. Return .... the blood that contains carbon dioxide back to the heart
   a- lungs b- vessels of the phloem
   c- Arteries d- Veins

6. The increase in pollution in the ecosystem will result in a/an .... in the number of species of organisms.
   a- increase b- decrease
   c- equality d- no change

Compare each of the following:

1. What happens to the plant in the light and in the dark.
2. Transport in plants and humans.
3. The producer and the consumer.

Put (✔) and (✘) in front of the following statements :

1. In plants, light energy is converted into chemical energy. ☐
2. Vascular systems differ in plants and humans and do not play the same role. ☐
3. Living organisms depend on each other for getting energy. ☐
4. An ecosystem consists of living organisms only. ☐
5. A food web is a group of interconnected chains that show multiple food relationships. ☐
6. Human activities in the environment affect only living organisms. ☐

Rewrite the sentence after correcting the underlined word:

1. <u>Consumer</u> organisms help decompose the remains of dead plants and animals into nutrients that can be returned to the ecosystem.
2. High water temperatures cause coral reefs turn to <u>green</u>.
3. Producing organisms need <u>moon light</u> to perform photosynthesis.

Answer the following:

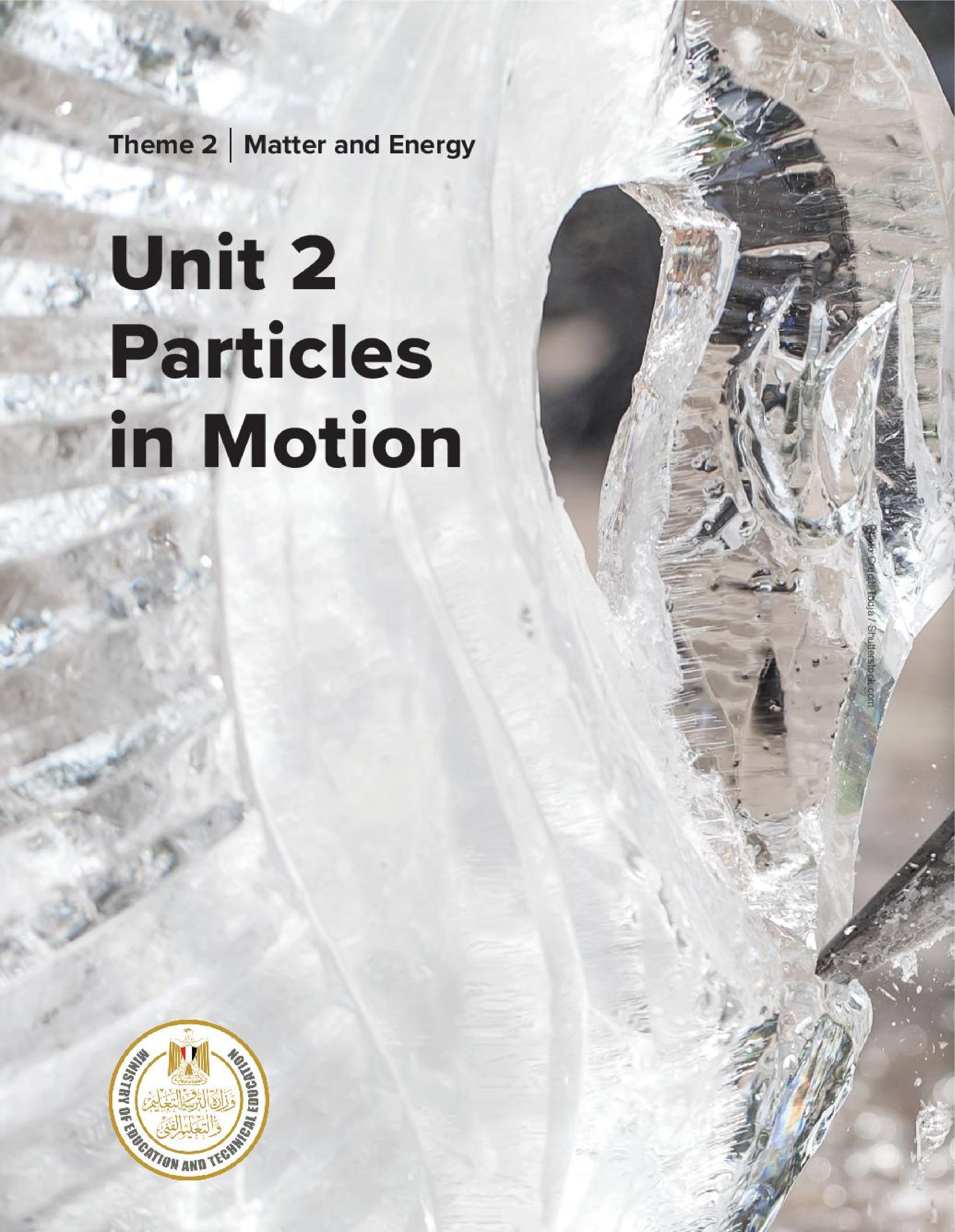






In front of you is a group of organisms, of which a food web is formed after completing the organisms, forming a food chain

Explain the levels of organisms in the chain



Theme 2 | Matter and Energy

Unit 2 Particles in Motion

Get Started

What I Already Know

You might not immediately think of a volcano when you hear the phrase *states of matter*. Look at the images. Think about what you know about gases, liquids, and solids. Can you find evidence of the different states of matter when observing a volcano?







Photo Credit: (a) Todja / Shutterstock.com, (b) T-I / Shutterstock.com, (c) Benny Marty / Shutterstock.com, (d) Creative by Nature / Shutterstock.com, (e) Icon made by Freepik from www.flaticon.com

Write about what you already know about the different states of matter. Use evidence from the different images of volcanoes provided.

____

____

____

Talk Together Where else can you easily observe different states of matter? Share with a partner about places in your home or school where you might observe solids, liquids, or gases.

During this unit, you will learn that matter is composed of very small particles that behave differently in solid, liquid or gas form. You will also learn more specific ways to identify, describe, and measure matter. You will learn that matter can change physically (mixing, temperature, and state) as well as chemically (new substances formed). Finally, you will bring together all of your knowledge and apply it to the Unit Project: Slippery Sands.

Get Started

Sands of Time



You probably already know a lot about sand. Maybe you have been out in the desert, or perhaps you have spent the day at the beach. Think about what happens when you pick up a handful of sand and let it run between your fingers. Now, picture how sand changes when it mixes with water, such as at the seashore. Sometimes people use sand to keep track of time. An hourglass is a tool that holds sand in one compartment. When the hourglass is set on one end, the sand runs from the top section into the bottom. Consider the following scenario.

Ahmed asks his grandmother to make him a boiled egg for breakfast. He watches as she takes a small device filled with sand and flips it over, so the sand runs from the top to the bottom of the device. She tells him that when the sand has run out of top, the egg will be done. In this unit, you will describe and measure properties of materials like sand. At the end of this unit, you will be able to describe the properties of sand, including its state of matter, and explain how it may have been used in creating the ancient pyramids.



Hourglass with Sand

How are different states of matter unique? How can models help us to understand changing states of matter? How can matter be described and measured?

Unit Project Preview



Solve Problems Like a Scientist

Unit Project: Slippery Sands

In this project, you will use what you know about the properties of various states of matter. You will apply what you have learned about mixtures and investigate how sand may have been used to move the extremely heavy blocks that make up ancient pyramids.



Pyramids of Giza

Ask Questions About the Problem

You are going to experiment with a mixture of materials in two different states of matter: sand and water. You will investigate how these two materials can be combined in a way that makes objects slide more easily across a surface. Write some questions that you want to ask about the different states of matter or how different materials can be combined. As you learn more about matter and the properties of different materials in this unit, record the answers to your questions.

Life Skills **I can apply an idea in a new way.**

Photo Credit: (a) Todja / Shutterstock.com, (b) WitR / Shutterstock.com

CONCEPT 2.1

Matter in the World around Us

Student Objectives

By the end of this concept:

- [ ] I can communicate the defining characteristics of the three states of matter.
- [ ] I can explain how changes in states of matter result in changes to the movement of the particles within matter.
- [ ] I can develop models of particles of matter in different states.

Key Vocabulary

- [ ] gas
- [ ] liquid
- [ ] mass
- [ ] material
- [ ] matter
- [ ] model
- [ ] particle
- [ ] property
- [ ] solid
- [ ] state of matter

Photo Credit: Smit / Shutterstock.com



Activity 1

Can You Explain?



Matter is everywhere. Scientists study matter in order to learn more about the world around us. What are the different forms of matter that can be found in the world around us? Look at the image and record what you already know about the types of matter that you can identify.





Life Skills **I can share ideas I am not yet sure about.**

Activity 2

Ask Questions Like a Scientist

States of Water

Have you ever used ice cubes to make a drink cold on a hot day? Do you drink hot tea in the morning? Have you ever noticed steam rising from a kettle on the stove? Think about how you see water in the world around you as you look at the images.



Ice Cubes



Glass of Water



Steam

Matter can exist in different states, or forms. Each state has its own properties. Think about the three images of water. What is the same in the images?
What is different?

Write your questions you have and share them with the class.

I wonder . . .

Life Skills **I can predict possible outcomes of an event.**



Activity 3

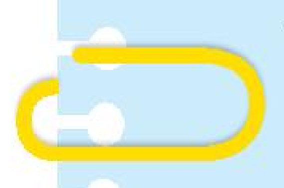
Investigate Like a Scientist

Hands-On Investigation: Observing Matter

Matter is everywhere. Scientists use observations of the various properties of the matter they are working with to determine if the matter is a **solid**, **liquid**, or **gas**. In this investigation, you will observe a variety of materials and use their properties to describe solids, liquids, and gases.

Make a Prediction

What do you think is in containers A, B, and C?



What materials do you need? (per group)

- Three opaque containers labeled A, B, and C
- A solid object
- A liquid
- A gas



What Will You Do?

As you complete the following steps, record your observations in the table provided.

1. Open the container labeled A and observe the properties of the object.
2. Record your observations in the table (color, size, shape, and texture).
3. Decide if your object is a solid, liquid, or gas and record.
4. Repeat for containers B and C.

Record your data in the table provided.

2.1 Wonder

What are the different forms of matter that can be found in the world around us?

Container	Color	Size	Shape	Texture	Solid, Liquid, or Gas
A					
B					
C					

Think About the Activity

How can you describe a solid?

How can you describe a liquid?

How can you describe a gas?

How are solids and liquids alike?

If a gas is invisible, what are some ways we know it is there?



Activity 4

Analyze Like a Scientist

Matter

All matter is made of moving particles. How much these particles move determines the **state of matter**. Read the text about matter and highlight evidence that you can use to answer the question: What are the different forms of matter that can be found in the world around us? Discuss with your class and share any questions you have with your teacher.

What Is Matter?

Matter is anything that has **mass** and takes up space. The computer or book that you are using is matter. The juice you drink at breakfast is matter. The air you breathe is matter. Even you are matter. All matter is made up of tiny particles that are in continuous motion.



Matter is usually something that we can feel, see, or even smell. Matter takes up space, which means that most of the time we can observe matter to learn more about it. Some matter is too small to see with the human eye. Even things we cannot see, like air or germs, are made up of matter. So, what is matter actually made of?

Matter is made up of tiny particles. Your hand, desk, and pencil, for example, are all made up of millions of tiny particles.

States of Matter

How much the particles are moving determines the state of matter. Light and sound are two examples of things that are not matter. Both of these are considered forms of energy. Common states of matter are solid, liquid, and gas. In solid matter, each **particle** is packed tightly with the others and moves only a little bit.

In liquid matter, the particles have more space, have more energy, and move more freely.

In a gas, the particles have a lot of space and energy and move very freely. Matter can change from one state to another, and these changes, such as ice melting into water or water freezing into ice, happen all the time.

All matter is made up of particles. Matter can exist in three different states. Tables and walls in a classroom are examples of matter in a solid state. Solids keep their shape unless something is done to change them. Liquids can be poured. Liquids do not have a shape of their own but rather take the form of their container. Some matter is found in the form of a gas. The air that we breathe is a gas. The air in a balloon is gas. All gases will completely fill a closed container. An example is when you pump air into a bicycle tire tube. Matter in any form—solid, liquid, or gas—takes up space. No two objects can take up the same space at the same time.

Measuring and Observing Matter

All matter can be measured and observed. For example, you can measure how tall you are with a meterstick or a measuring tape. You can measure how much a puppy weighs using a scale. You can observe air filling up a balloon, and you can measure how much the balloon expands as it fills. You can observe milk being poured into a glass and measure the amount and temperature of that milk.



Talk Together Now, talk together about how you could define the different states of matter.



Talk Together Now, talk together about why you think we cannot see with our eyes the individual particles that make up matter.



Activity 5

Analyze Like a Scientist

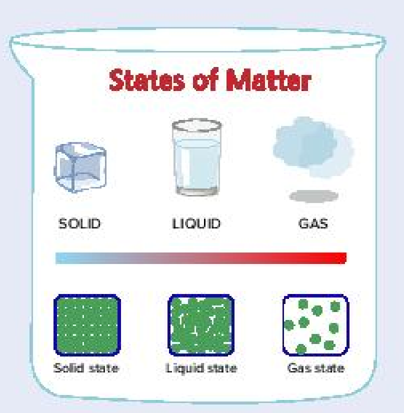
Particles of Matter

Read the text. Then, highlight evidence to support this claim: Particles are called “the building units of matter.”

Everything Is Made of Matter

Everything around you, even your body, is made up of matter. We define matter as anything that has mass and takes up space. Solids, liquids, and gases are all states of matter.

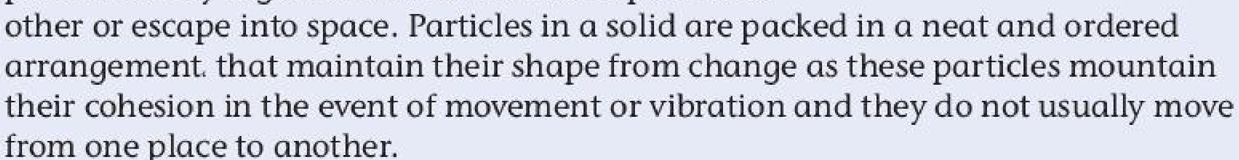
Particles Are Extremely Small



Imagine what would happen if you could break down a chunk of matter, like a piece of gold, into pieces. The pieces would get so small you could no longer see them, even with a microscope. You would end up with extremely small pieces of matter called particles. There are many different types of particles.

Particles in Solids

Solids are made of particles. The particles are packed closely together and cannot move past each other or escape into space. Particles in a solid are packed in a neat and ordered arrangement. that maintain their shape from change as these particles mountain their cohesion in the event of movement or vibration and they do not usually move from one place to another.



Particle in liquid

Liquid materials consist of particles that are linked with each other by less bonds than in the solid state allowing them to move and move a way from each other which allows the liquids to take the shape of the container in which they are placed and the particles in the liquid state move much faster than the particles in the solid state.

Particles in gases

Gaseous substances consist of incoherent particles , that can spread to fill any container they are placed in and the particles in the gaseous state move very quickly.



Activity 6

Evaluate Like a Scientist

Modeling the Particles of Matter

Read the scenario. Write or draw a note to your friend describing what happened. In your note, use one or more of the following terms: matter–particle–solid–liquid–gas.

You and a friend are playing with ice cubes outside on a hot summer day. You are both called away to do a chore and forget to clean up. Several ice cubes are left on a table outside in the sun. When you return several hours later, there are no ice cubes or water left on the table and your friend is puzzled and worried. What happened to the ice cubes?

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____

____

Your student group is developing a model to show how particles make up matter. Your job is to choose an object to represent particles in the model. Which object will you choose?

A. syrup

B. ping pong balls

C. tiny pieces of paper

D. a rainbow

Now, explain why you chose the objects you did.

____

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Activity 7

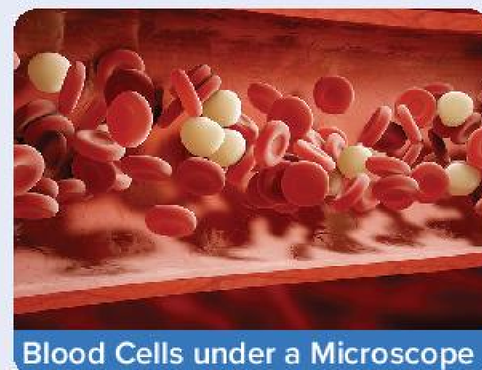
Analyze Like a Scientist

Tiny Particle Size

Particles can be incredibly tiny. Some are so small that even normal microscopes cannot detect them. Read the text that follows to find out how small particles can be. Next, work with a partner to record information from the text that helps you to support the explanation that tiny particles make up matter.

Tiny Particles

The exact size of a particle depends on the type of particle and how it connects with neighboring particles. The average size of a particle is so tiny that one of your hairs is about 150,000 to 300,000 particles thick.



Blood Cells under a Microscope

How Can We See Each Particle?

Scientists can use special microscopes called electron microscopes to see individual particles. The microscopes you have in a regular science classroom are not powerful enough to see them. If the tiny size of particles makes them too small to see, even with microscopes, how can we tell they are actually there?

How Can We Show That Particles Exist?

Examining gases can help demonstrate that these invisible particles really do exist. Think about what happens when you blow up a balloon. Even though the gas in the balloon is invisible, it still is made up of particles of air. The particles in a gas move very quickly. They bounce against the inside of the balloon. This exerts a force that inflates the balloon and creates its round shape. If you squeeze the balloon, you can make it smaller by pushing the particles closer together. But if you squeeze it too hard, the balloon pops, and the particles that were inside escape into the air.

Evidence that tiny particles make up matter:

Activity 8

Observe Like a Scientist

Models

Read the text. Then, discuss what you know about models.

A Globe Is a Model

All of Earth is too big to see while standing on it. Astronauts can see most of Earth while riding in a spaceship. A globe is a **model** of Earth. It is not a real planet. A model is a copy that is similar to the real thing. Models look like, move like, or work like what they copy. A globe shows you the shape of Earth. On a globe you can see how much of Earth is covered in ocean and where different countries are located.



How Do Models Help Us Look at Big Things?

Lots of gigantic things are hard to see. Models can bring them down to size. The solar system is a very big place. Planets are very big objects. A solar system model shows us all the planets at once. It helps us compare them. We can see which planet is biggest and which one is closest to Earth.

How Do Models Help Us Look at Small Things?

Very tiny things are hard to see too, such as a single grain of sand. Germs are also very tiny. Germs make you sick. We spread germs around, but we can only see them with microscopes. Models of germs can show you what they look like without a microscope. You can see the different parts that help germs spread from one person to another.

Models Help Us Understand How Things Work

What makes a volcano explode? Why does an airplane fly? Models can show us. Model volcanoes ooze liquid to model what happens during a real eruption. A model airplane flies up into the air. So does a real airplane. Models are not the same as the real thing, but every model teaches us something about the real thing it copies. Models help us see and understand how things work. They show us what we could not otherwise see. Models are a great way to see and learn about many things at just the right size.



Activity 9

Investigate Like a Scientist

Hands-On Investigation: Modeling States of Matter

Models help us understand things that are too big or too small to study directly. A model can help you picture in your mind something that is difficult to see or understand. In this activity, you will develop a model to represent the different states of matter: solid, liquid, and gas.

Make a Prediction

How will you use the materials to model the different arrangements of particles in each state of matter?



What materials do you need? (per group)

- Small buttons, beans, or other circular objects, about 40
- Glue
- Index cards or pieces of cardboard, 3, 10 x 15 cm or larger



What Will You Do?

1. Label one index card (or piece of cardboard) “Solid.”
2. Glue small items to the index card to create a model of particles in a solid.
3. Label another index card “Liquid.”
4. Glue small items to the index card to create a model of particles in a liquid.
5. Label the final index card “Gas.”
6. Glue small items to the index card to create a model of particles in a gas.

Think About the Activity

After you discuss your models with the class, think of other ways you could model the different states of matter. Could you use movement to show how the particles of solids, liquids, and gases behave? Once you have analyzed your model and considered other modeling methods, write your answers to the questions that follow.

Describe the arrangement of particles in the different states of matter you modeled in this investigation.

____

____

What is matter composed of?

____

____

Give examples of solids, liquids, and gases that you use every day.

____

____

What does the arrangement of particles in solids, liquids, and gases tell us about how materials in each state will behave?

____

____

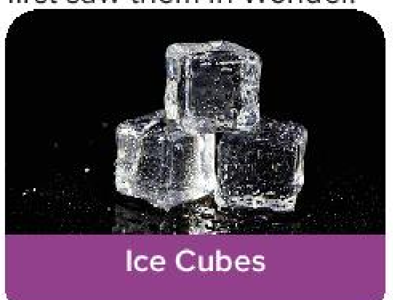


Activity 10

Record Evidence Like a Scientist

States of Water

Now that you have learned about States of Water, look again at these three images. You first saw them in Wonder.


Ice Cubes


Glass of Water


Steam

How can you describe States of Water now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

What are the different forms of matter that can be found in the world around us?

Now you will use your new ideas about matter in the world around us to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, What can you conclude? It should not start with *yes* or *no*.

My claim:

Next, record the evidence that supports your claim. Evidence can come from videos, readings, interactives, and Hands-On Investigations.

Evidence:

STEM in Action



Activity 11

Analyze Like a Scientist

Careers and States of Matter

You may think of states of matter as something that you only learn about in the classroom. But there is a career you are probably familiar with that relies on the three common states of water every day—a chef. Read the text to learn how chefs use kitchen science daily.



Think about the times you have seen or helped prepare food by cooking. Perhaps you have seen an adult boil some water to cook pasta or rice. Did you see the steam? That is water as a gas. Maybe there were some frozen vegetables added to the meal. Freezing vegetables keeps them fresh and ready to use for longer periods of time. Have you ever guessed what was for dinner just by the smell, or aroma, coming from the kitchen? Think about what state of matter helps us perceive aromas.

Scientist Chef

Chefs use science to help prepare creative and delicious dishes. As you watch the video, notice how the chefs use the different states of matter to change ingredients. Like a professional chef, you can experiment with different states of matter in your kitchen. Think about what happens when you add

Life Skills I can apply an idea in a new way.

boiled vegetables to a bowl of cold ice water. What happens to the ice in the water? What happens to the hot vegetables? Have you ever taken a plate of hot food and placed it into the refrigerator or freezer to cool down? How long would you need to leave a cup of juice or milk in the freezer before the state of matter changed from liquid to solid? What other ways can you use ingredients representing different states of matter to prepare or cook food for a meal?

Taste the States of Matter

Imagine that you are a chef, and you want to impress your guests with a special theme dinner called "Taste the States of Matter." You need to plan a creative meal that includes various flavors and illustrates the three main states of matter. What would you prepare for your guests? How would you plan the meal? Are there any safety considerations you or your guests would have to take?

CONCEPT 2.2

Describing and Measuring Matter

Student Objectives

By the end of this concept:

- [ ] I can classify materials based on their properties and describe patterns in the properties of similar materials.
- [ ] I can choose the appropriate tools to measure the size and volume of different kinds of materials in different states of matter.
- [ ] I can plan and conduct investigations to gather and record information about the properties of various materials.
- [ ] I can analyze data to identify unknown materials.

Key Vocabulary

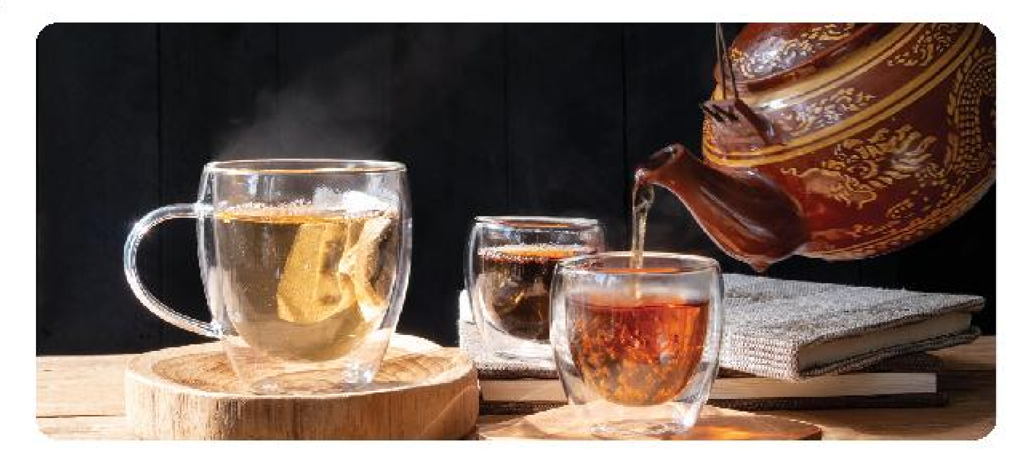
- [ ] mass
- [ ] material
- [ ] matter
- [ ] measure
- [ ] property
- [ ] substance
- [ ] volume

Lesson 1



Activity 1

Can You Explain?



Now that you know more about different states of **matter**, think about how we describe matter. We have different ways to describe the properties of matter. Write what you know about how we describe different properties of matter and how we could **measure** some of those properties.

How is matter described and measured?

____

____

____

____

____



Life Skills **I can share ideas I am not yet sure about.**

Activity 2

Ask Questions Like a Scientist

A Roof for Every Type of Climate

As you look at these three images of buildings, pay special attention to the roofs. What materials are the roofs made of? How are they different? Why do we find different kinds of roofs in different climates? After examining the images, record your questions and ideas.


Desert Home


Cold Weather Home


Tropical Rainforest Home

What do you wonder about the properties of different roofing materials? Write two questions you have and share them with the class.

I wonder . . .

I wonder . . .



Activity 3

Evaluate Like a Scientist

What Do You Already Know About Describing and Measuring Matter?

Now it is your turn to share what you already know about describing and measuring matter.

Describing Matter

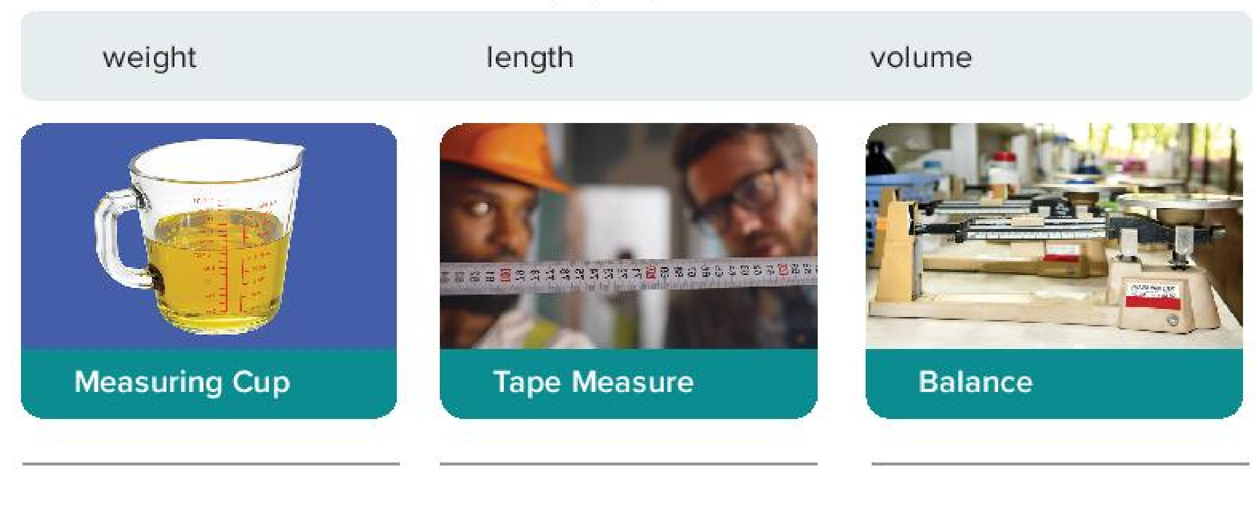
You already know that matter is anything that takes up space. Matter can be a solid, liquid, or gas. Look around. Matter is all around.

What are some ways you can describe matter?

Measuring Matter

Look at the pictures. Which tool would you use to measure volume? Which tool would you use to measure length? Which tool would you use to measure weight? Use the word bank to label each tool with the property that it measures.

weight | length | volume



Measuring Cup ______

Tape Measure ______

Balance ______

Why is it useful to measure different properties?



Activity 4

Investigate Like a Scientist

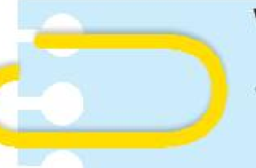
Hands-On Investigation: The Case of the Kitchen Mystery

In this investigation, you will examine a variety of substances that look alike. Most of the substances are labeled, but one is a unknown. You will use your senses and other methods of observation to describe the properties of each **substance** and try to predict what the unknown substance is.

Make a Prediction

Predict which sense will be the most helpful in solving this unknown—sight, smell, or touch—and explain why.

Photo Credit: zevana / Shutterstock.com



What materials do you need? (per group)

- Plastic bag with 20 g sugar, labeled
- Plastic bag with 20 g salt, labeled
- Plastic bag with 20 g baking powder, labeled
- Plastic bag with 20 g baking soda, labeled
- Plastic bag with 20 g flour, labeled
- Plastic bag with 20 g of unknown mixture, labeled
- Spoons
- Hand lenses
- Piece of black construction paper, 25 cm x 10 cm
- White crayon or colored pencil
- Microscope (optional)



What Will You Do?

As you complete the following steps, record your observations in the investigation chart provided.

1. Draw six circles in a row on the black construction paper using the white crayon.
2. Label each circle with the name of a substance on your tray.

3. Label the sixth circle "unknown Mixture."
4. Place a small amount of each known substance and the unknown mixture (about 10 g) in the appropriate circle.
5. Record your observations, such as color, texture (such as fine or coarse, compact or loose, dull or shiny, rough or soft), odor, and shape of the substances.
6. Use hand lenses and a microscope if available.

Record your data in the investigation chart provided.

Substance	Color	Texture	Odor	Other Observations
Unkown Mixture				

Think About the Activity

How were all of the substances (sugar, salt, baking powder, baking soda, and flour) similar to one another in terms of their physical properties? How were they different?

How did the hand lens help your observations?

If these substances were not labeled, could you tell them apart by just their physical properties?

Can you predict what is in the unkown mixture?



Activity 5

Analyze Like a Scientist

Properties of Matter

You have now learned a variety of ways to describe and measure matter. Now, read the text to discover more ways that matter can be observed and measured. Once you have completed the reading, circle the properties of matter you can observe and measure. Add your notes to your placemat.

Properties of Matter

Physical Properties of Matter

Matter has many properties that you can describe. Color, shape, odor, and texture are examples of physical properties that you can observe with your five senses. You can use words such as *rough*, *blue*, *floral*, *round*, and *sweet* to describe these properties.



A Burning Match

Photo Credit: zevana / Shutterstock.com

Chemical Properties of Matter

The ability to burn and the ability to rust are properties that describe how matter interacts with other matter. These are called chemical properties. An important feature of chemical properties is that they are only measurable by changing the **material**. For example, a chemical **property** of paper is that it is flammable. When paper is lit on fire, it becomes ash. The image shows a burning match. What kind of property is the ability to burn?

Volume and Mass

Volume and temperature are properties of matter that you can measure. Volume is the amount of space that matter takes up. Scientists measure volume in liters (L), milliliters (mL), or cubic centimeters (cm^3). One liter equals 1,000 milliliters or 1,000 cubic centimeters (1 L = 1,000 mL = 1,000 cm^3). A big bottle of soda or juice that you might buy for a party can hold 1L or more.

Mass is a measure of the amount of matter. Scientists often measure mass in grams (g) or kilograms (kg). A paperclip has a mass of about 1 gram. One kilogram is equal to 1,000 grams (1 kg = 1,000 g). One liter of water has a mass of 1 kilogram.

Temperature

Recall that matter is made up of particles in motion. Temperature is a measure of how quickly the particles in a substance are moving. Quickly moving particles can give off more heat energy than slower moving particles.



Activity 6

Investigate Like a Scientist

Hands-On Investigation: Measuring Properties

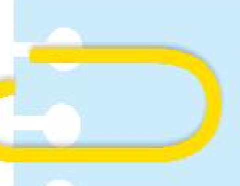
You now know how to use properties to describe matter. Scientists use tools to investigate materials. In this activity, your group will be working with a variety of materials and tools. Your group will be measuring various physical characteristics of matter, including mass, length and the ability to sink and float.

Make a Prediction

Think about the two questions that follow. Make your predictions. Then, investigate the answers to these questions as you explore the properties of all the materials.

If you cut an object in half, how does the mass of one of the pieces compare to the mass of the original object?

What do you think makes an object float?



What materials do you need? (per group)

- Bar magnets
- Balance
- Water
- Metric ruler
- Beaker, glass, 150 mL
- Paper clips
- Beads
- Aluminum foil



Photo Credit: zevana / Shutterstock.com

What Will You Do?

1. Choose objects to investigate that you can observe or measure.
2. Choose different properties to investigate. You do not need to study all the properties listed in the data table.
3. Decide on an additional property, one that is not listed, to study with your group.
4. Determine the tools needed to investigate each property.

5. Describe the objects using as many properties as possible. Make measurements and observations using the tools you chose to use.
6. Record your data in the table.
7. Use the tools to find out if your predictions about mass and the ability to float were correct.
8. Sort your objects into groups.
9. Record what you observed in the space provided.

Which properties did you study?

Write the type of object at the top of each column. Then, record a description of the properties you observed.

Property	Object	Object	Object	Object
1: Color				
2: Sink or Float				
3: Texture				
4: Mass				
5: Attracted to Magnet or Not				
Other Properties:				

Think About the Activity

What tools did you select for this investigation?

How does changing the size of an object change its physical properties?

Describe one of your groups. What objects did you include in that group? Why did you group those objects together?



Activity 7

Evaluate Like a Scientist

Measuring Matter

You have learned a lot about using measurements to compare materials and properties of matter. Now it is your turn to share what you know.

Measuring Matter

Sahar measured several materials. Her measurements are in the table. Note that mass is measured in grams (g), length is measured in centimeters (cm), and volume is measured in milliliters (mL). Examine the data in the table carefully and look for patterns in the data.

	Mass (g)	Length (cm)	Volume (mL)
Material 1	189	37	100
Material 2	150	55	115
Material 3	99	23	5

Based on the data in the table, select the correct words to make each statement true.

1. ______________________ [Material 1/Material 3] contains **more matter** than Material 2.

2. ______________________ [Material 2/Material 3] is **longer** than Material 1.

3. ______________________ [Material 2/Material 3] takes up **more space** than Material 1.



Talk Together The importance of understanding and measuring matter for different professions such as (bakers, scientists and cartographers)..



Activity 8

Analyze Like a Scientist

Useful Properties of Matter

In this activity, you will read about the useful properties of helium, copper, and glass. You might not know very much about these materials at this point. After you read the passage, consider other uses for a variety of different materials.

Helium



Have you ever seen a party balloon, such as the one pictured? Helium is a gas that is used to fill balloons. Its properties make it useful for this purpose. For example, a balloon filled with helium gas is lighter than air. This means balloons filled with helium rise up in the air. This is a physical property of helium. Also, helium is not poisonous or flammable, so it is safe to use. (A flammable material is easily set on fire.) Both of these are examples of chemical properties.

Copper

Maybe you have seen a copper cooking pot or a copper wire. Copper is a metal commonly used to make electrical wires. Its physical properties make it useful for this purpose. Copper can be stretched into a thin, flexible wire, which is a physical property. Copper also conducts electricity well, which is another physical property called conduction. Conduction is when heat or electricity can easily pass through a substance. In contrast, it would not be useful to make wires out of a material like wood. Unlike copper, wood cannot be easily stretched and does not conduct electricity well.

Glass

Glass is used to make windows and light bulbs. You have probably seen numerous other objects made of glass. Think of other uses for glass objects. What properties of glass make it useful for these purposes?

What is another material for which there are specific applications?



Activity 9

Evaluate Like a Scientist

Uses of Matter

You have learned a lot about why the properties of a material can make it useful to perform a specific task. Now it is your turn to share what you know.

Choose the properties that make each type of material useful for its purpose.

hard	transparent	strong
waterproof	flexible	smooth

Types of Matter	Purpose	Property
Steel	Tools, such as screwdrivers and hammers	
Glass	Windows, eyeglasses	
Rubber	Tires, athletic shoes, gloves	





Activity 10

Record Evidence Like a Scientist

A Roof for Every Type of Climate

A roof needs to protect people from the weather, falling objects, and animals. The kinds of materials used to make a roof depend on where the roof is located. Places where it is hot need materials that will deflect the sun's heat energy. The ability of the material to pass some heat, but not too much, is considered a property of matter. Now that you have learned about properties of matter, consider the properties of various roofing materials used around the world. You first saw this in Wonder.



Desert Home



Cold Weather Home



Tropical Rainforest Home

How can you describe A Roof for Every Climate now? How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

How can you describe and measure matter?

Now you will use your new ideas about describing and measuring matter to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, What can you conclude? It should not start with *yes* or *no*.

My claim: ______________________________

Next, record the evidence that supports your claim. Evidence can come from videos, readings, interactives, and Hands-On Investigations. Evidence:

____

Life Skills **I can apply an idea in a new way.**

CONCEPT 2.3

Comparing Changes in Matter

Student Objectives

By the end of this concept:

- [ ] I can explain the relationship between changes in temperature, states of matter, and mass.
- [ ] I can identify the causes of changes in the physical and chemical properties of matter.
- [ ] I can investigate what happens when two or more substances are mixed.
- [ ] I can classify mixtures and compounds based on what happens when they are combined.

Key Vocabulary

- [ ] chemical change
- [ ] chemical properties
- [ ] compound
- [ ] energy
- [ ] friction
- [ ] heat
- [ ] light
- [ ] melt
- [ ] mixture
- [ ] physical change
- [ ] thermal energy
- [ ] water vapor



Activity 1

Can You Explain?



Look at the sweet treats in the photo. Can you observe a change taking place? Can you predict what will happen to this object as the change occurs? Matter can be changed. Think of a time when you observed a change in matter.

What happens to the mass of a substance when it is heated, cooled, or mixed with other substances?



Life Skills **I can share ideas I am not yet sure about.**



Activity 2

Ask Questions Like a Scientist

Melting Matter

Watch an ice cube melting. Then, and read the text. Brainstorm questions about melting matter with your partner. Some questions are open-ended, meaning they have lots of ways to be answered. Some questions are simple and can be answered with a yes or no response. Think about how to make your questions be more open-ended. This means that your question may have more than one answer.

Imagine you have invited some friends over to your house. You realize that the juice box drinks you want to serve them are warm. You go into the kitchen. Your aunt is making hot tea on the stove. She gives you a metal bowl. You set the bowl next to the stove, fill it with ice, and place the juice box drinks into the ice. The problem is solved. Or is it? You come back 15 minutes later and find the juice boxes floating in a bowl full of water. What happened? Why did the ice **melt** so quickly?



Consider what happened in the story about the bowl full of ice. With a partner, talk about what you think happened. Discuss other questions you might have about melting ice cubes. Record three questions you have about a melting ice cube in the chart provided.

I wonder . . .
I wonder . . .



Activity 3

Analyze Like a Scientist

Particles

First, imagine you could shrink to the size of particles in a cup of hot tea. Then, read the text about Particles in Motion. After reading about the interaction of matter and **heat** **energy**, think about how you could model particle motion using marbles or another physical representation. Imagine you could shrink to the scale of the tiny particles that make up matter and move around in a cup of tea. Write about or draw what you would experience.

Particles in Motion

Thermal Energy

Heat is a form of energy you use every day. You heat your hands in front of a fireplace and cook bread in a hot oven. You use heat to warm your home. Heat from the sun keeps living things on Earth alive. Heat is not a physical thing or material, like a cup of hot tea. It is simply a form of energy that can make tea hot. Heat is also known as **thermal energy**.

Matter

Matter is anything that takes up space and has mass. Tea, like all matter, is made of extremely small particles. These particles have energy. This energy makes the particles move, vibrate, and spin around. When **light** energy or thermal energy is absorbed by matter, the particles in the matter move and vibrate faster. The faster this movement, the more thermal energy the object has. The more thermal energy the object has, the warmer it is to the touch. It is important to remember that the particles that make up matter are always moving in some way.



Hot Cup of Tea

How can marbles or other visible particles act as a model to describe and explain some of the properties and behavior of matter? Write or draw your ideas.



Activity 4

Analyze Like A Scientist

Temperature and State of Matter

You observed how chocolate can melt into a liquid and then form back into a solid. How does that happen? Read the text. Underline evidence that you can use to answer the Can You Explain? question.

A substance's state depends partly on its temperature. A substance's temperature is a measure of how much energy the particles in that substance have. It is the energy of the particles that determine how much they move and, therefore, the state of the matter.



How Water Changes State

For example, water is a liquid between 0°C and 100°C. Water becomes a solid when it is cooled below 0°C, which is its freezing point. Its state changes from liquid to solid. As the particles of liquid water lose energy, they slow down until the liquid water becomes solid ice.

Melting

Melting is the opposite process. Melting is the change of state from solid to liquid. It happens when energy is transferred to a solid. For example, as particles of solid ice gain energy, they move around more. Eventually they move around enough that the ice begins to melt. Melting happens when the temperature of ice rises above 0°C.



Frozen Treats Changing State

Physical Changes

Changes of state are often caused by changes in temperature. Changes of state are physical changes. Physical changes do not change the makeup of a substance. They are also usually reversible. For example, melting is a **physical change** that can be reversed by cooling liquid water until it freezes again. The water is still water. It is the same substance whether it is liquid or solid, even though it looks different. Increasing or decreasing temperature can also cause chemical changes.

Think about the chocolate you observed in the Hands-On Investigation: Changing States of Matter. Fill in the graphic organizer provided. Draw a model of the chocolate before you applied heat. Draw a model of the chocolate after you applied heat. In the box at the bottom, write an explanation for the changes you observed. Include what you now know about the addition or loss of energy as the state of matter changed.

Before	After

Changes



Activity 5

Observe Like a Scientist

What's the Matter? Changing States

Matter can exist in three states: solid, liquid, and gas. How can we change matter from one state to another? Can we change it back again? Complete the interactive What's the Matter? Changing States, read the text passage, and answer the questions.

Water can exist in three states: solid, liquid, or gas. Water as a solid is called ice. Water as a gas is called **water vapor** or steam. When the temperature of a substance goes up, the particles move and vibrate a lot more. The extra energy allows the particles to change to a different state. When the temperature goes down, the particles slow down and move together.

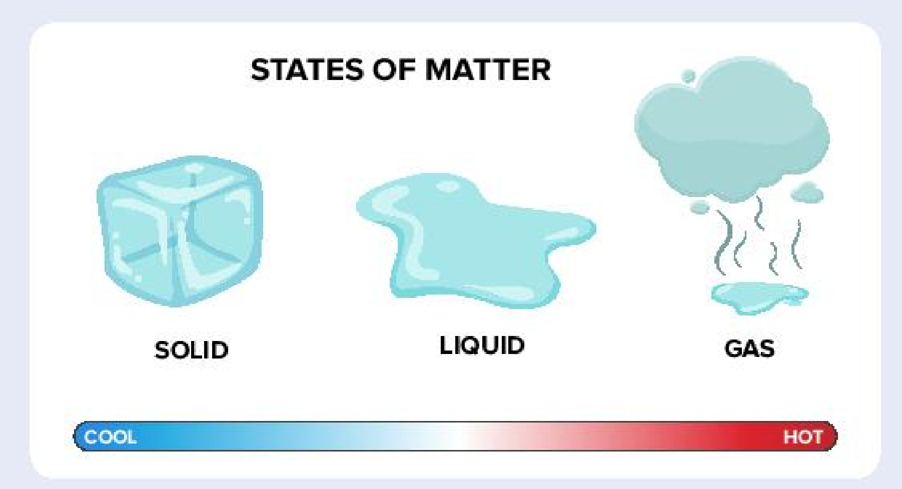


Photo Credit: K.-U. Haessler / Shutterstock.com

Changing a Liquid to a Gas

Imagine you are in a kitchen. Picture a container of water sitting on a counter. If you add heat, or thermal energy, by placing the container of liquid water on a hot stove burner, the particles vibrate and separate. The liquid water boils away. It changes to water vapor and is invisible in the air. The white, cloudlike mist coming from boiling water is steam. After the hot water vapor hits the cooler air, it condenses into tiny water droplets, forming a small cloud, which we call steam.

Life Skills I can share ideas I am not yet sure about.

Changing a Gas to a Liquid

To change the gas, water vapor, back into a liquid, you must cool the gas. Cooling the gas transfers the energy back to the cooler environment. The particles slow down and form a liquid. If it is cold outside, you can see water droplets from the steam form on a window. You can use a rubber wiper to collect the water droplets into a container.

Changing a Liquid to a Solid

Take the liquid water container and place it into the freezer. By transferring energy from the liquid water to the space in the freezer, the particles slow down and move even closer together. You just changed liquid water to solid water, or ice.

Changing a Solid to a Liquid

Place the container with ice cubes back onto the hot stove burner. The thermal energy, in the form of heat from a stove burner, causes the particles to move more and separate. This changes the solid to a liquid. Matter can change from one state to another when thermal energy is gained or lost.

Describe what happens to liquid water when it is heated (gaining thermal energy). How does this change affect particle movement?

Describe what happens to liquid water when you remove heat (remove thermal energy). How does this change affect particle movement?

Describe what happens to solid ice when it is heated (gaining thermal energy). How does this change affect particle movement?



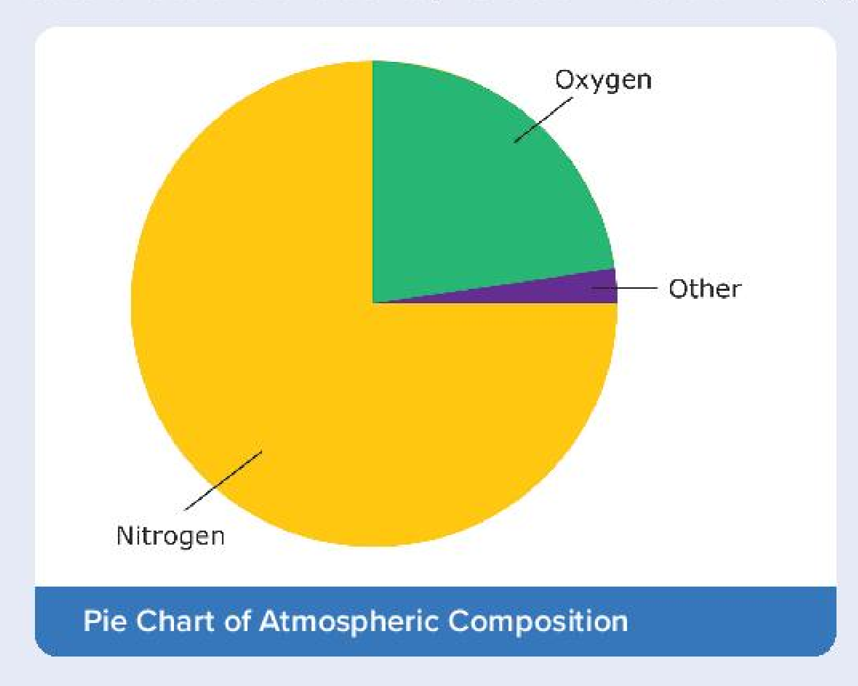
Activity 6
Analyze Like a Scientist

Mixtures

Mixtures are absolutely everywhere you look. Most things in nature are mixtures. Read the text Then, consider how you might go about separating the parts of some mixtures.

Mixtures

A mixture is a form of matter made of two or more parts. A mixture is different from a **compound**. A compound is also a form of matter made of two or more parts, but the parts combine chemically to form a completely new substance. In a mixture, each part keeps its own identity. In other words, mixing the parts does not change them into new substances. A mixture can be made of solids, such as a mixture of sand and small rocks. Or it can include a combination of a solid and a liquid, such as salt water. Earth's atmosphere is a mixture of many gases.

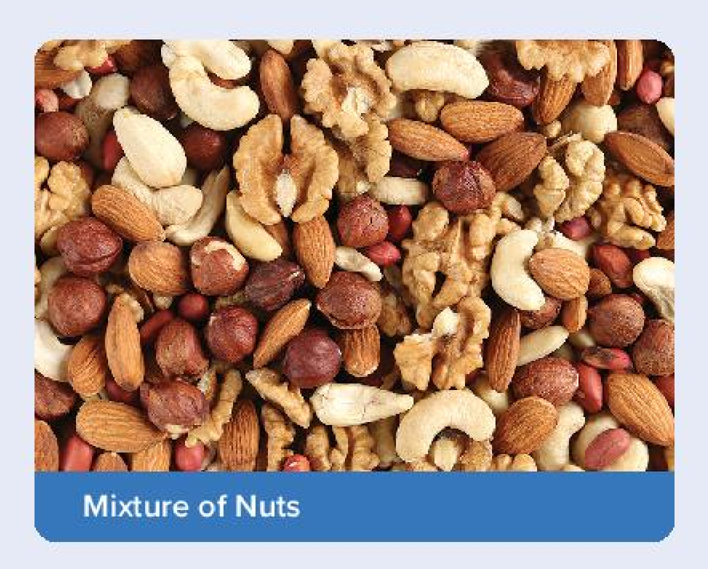


Pie Chart of Atmospheric Composition

Life Skills I can share ideas I am not sure about.

Mixture of Nuts

Compare a mixture of different types of nuts with a mixture of gases. Both are types of mixtures, and both have different parts. But you can easily see the different parts in the mixture of nuts. You would need special equipment to see the parts in a mixture of gases. Can you think of other common mixtures you encounter in your daily life?



Mixture of Nuts

Properties of Mixtures

When materials are mixed and form a mixture, they do not combine chemically. Each material keeps the properties that you can use to identify it. For example, sugar does not lose its sweetness when it is mixed with water.



Water Filter

Separating Mixtures

You can separate the parts of a mixture. There are different methods to separate mixtures. Filtration can separate mixtures. A filter works if one material has smaller particles than the other. Evaporation can separate some mixtures. This works because the materials will evaporate at different temperatures.

Talk Together Think about two of the mixtures that you just read about: the mixture of nuts and the sugar water. With a partner, discuss the best method for separating each part of these mixtures.



Activity 7

Investigate Like a Scientist

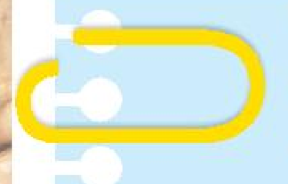
Hands-On Investigation: Mixing It Up with Mass

Mixtures are everywhere. You can always tell a mixture, because each of the substances can be separated from the group in different physical ways. In this investigation, you will explore what happens when you mix substances together.

Make a Prediction

Today you will make mixtures of solids and liquids. How do you think combining substances affects the mass of a mixture? What do you predict will be the result of the investigation? Develop a claim about what you think is going to happen.

How will you investigate the question? Describe the plan that you will use to study the question and analyze your hypothesis.



What materials do you need? (per group)

- Scale or balance
- Spoons
- Weighing dishes
- Plastic resealable bags
- Baking soda
- Flour
- Cornstarch
- Epsom salts (magnesium sulfate)
- Water
- Vinegar
- Lemon juice
- Iodine
- Juice from purple cabbage
- Powdered lemonade or other drink powder
- Safety goggles (per student)
- Disposable gloves, 2 (per student)



What Will You Do?

Part 1: Mixing Solids

1. Choose two solids. Ask your teacher to confirm your choices.
2. Ask your teacher if you need to review proper weighing technique. You will need to record the masses of the substances that you choose with precision.

3. Place the weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of Solid 1 to the weighing dish. Record the mass and set the weighing dish aside.
4. Place a new weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of Solid 2 to the weighing dish. Record the mass and set the weighing dish aside.
5. Find the mass of a plastic zipper bag and record it.
6. Add Solid 1 and Solid 2 to the resealable bag and close the bag.
7. Mix the two solids with your hands by massaging the resealable bag from the outside. Record your observations.
8. Find the mass of the resealable bag that contains the two solids and record it.

Part 2: Mixing Liquids

1. Choose two liquids. Ask your teacher to confirm your choices.
2. Place the weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of Liquid 1 to the weighing dish. Record the mass and set the weighing dish aside.
3. Place a new weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of Liquid 2 to the weighing dish. Record the mass and set the weighing dish aside.
4. Find the mass of a resealable plastic bag and record it.
5. Add Liquid 1 and Liquid 2 to the resealable bag and close the bag.
6. Mix the two liquids with your hands by massaging the resealable bag from the outside. Record your observations.
7. Find the mass of the resealable bag that contains the two liquids and record it.

Part 3: Mixing Solids and Liquids

1. Choose a solid and a liquid. Ask your teacher to confirm your choices.
2. Place the weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of the solid to the weighing dish. Record the mass and set the weighing dish aside.
3. Place a new weighing dish on the scale and set the scale to read 0.0 g with the empty weighing dish on the pan. Add approximately 1 g of the liquid to the weighing dish. Record the mass and set the weighing dish aside.
4. Find the mass of a resealable plastic bag and record it.

5. Add the solid and the liquid to the resealable bag and close the bag.
6. Mix the solid and the liquid with your hands by massaging the zipper bag from the outside. Record your observations.
7. Find the mass of the resealable bag that contains the solid and the liquid and record it.

Record your data from your investigation. Compare your data with that of your classmates.

Mixture	Substances	Mass before Mixed (g)	Mass after Mixed (g)
Solids	1. 2.	1. 2.	
Liquids	1. 2.	1. 2.	
Solids and Liquids	1. 2.	1. 2.	

Think About the Activity

What did you learn from this investigation? Develop a conclusion for your investigation.

What happened to the properties of the substances when they were mixed?

What did you observe regarding the mass before and after mixing?

What patterns do you observe in the class data collected in this activity?



Activity 8

Observe Like a Scientist

Physical Changes in Our Lives

Changes occur all around us every day. Physical changes can change the size, shape, or even state of matter, but they do not cause something new to form. Read the following passage and record changes you think are physical changes and changes you think form something new.

Physical Changes in Our Lives

Last weekend, we went to the Khan Al-Khalili market in Cairo. There were so many things to see and buy. My mother looked at a gallebaya. The sleeves were too long, but she said it was easy to cut off some material.



Clothing

Food in the Market

Next, we found a market with some fresh fruits and vegetables. We bought lemons, tomatoes, bell peppers, red peppers, and red onion. At home, we will cut the fruits and vegetables into small pieces for a salad. All the walking made us hungry, so we stopped for a falafel. They were making the pita bread there. I watched as the baker mixed flour, water, sugar, and yeast. Then, he put it in an oven. The baked bread did not look anything like the ingredients when it came out of the oven.



Market

Gifts

We passed by some pretty lamps for sale. Some had black spots on the metal. My mother said that sometimes when the metals mix with oxygen in the air, it forms black spots called tarnish. Some of the lamps had candles. You could see where some of the wax melted and dripped down the sides of the candle. As we continued, we found the perfect gift for my aunt's birthday. It was a small box with pieces of shells on it. The artist broke the shells into tiny pieces that he very carefully put into the wood in a special design. Now that we had everything we needed, we headed back home.

Record the physical changes that took place in the reading passage in the chart under "Physical Changes." Record all other changes under "Not Physical Changes."

Physical Changes	Not Physical Changes



Activity 9

Analyze Like a Scientist

Chemical Changes

Any time a new substance is made, a chemical change takes place. Usually, two or more materials are combined, and a new substance is formed. Read the text. Look for the changes. Then, answer the questions that follow.

Chemical Changes

A chemical change produces a new kind of substance. The new substance is different physically from the original substance. However, it also has different chemical properties.

Examples of Chemical Changes



Rust on Car

For example, the elements iron and oxygen combine to form rust. Rust is a flaky, reddish chemical called iron oxide. You may have seen rust on the outside of a vehicle or on an old nail. When oxygen combines with carbon and hydrogen, they release heat that can start a fire. The fire can change a substance such as wood into ash. Mixing vinegar with baking soda produces a gas as bubbles form. Chemicals produced in your body help food digest. Unlike physical changes, chemical changes are not reversed easily.

Chemical changes are happening around us all the time. Iron toys left out in the rain become rusty, and cookies in the oven become baked. Think about which chemical changes were described in the text and answer the question that follows.

What are some examples of chemical changes that were described in the text? Describe which materials combined and what substance the chemical change made.



Activity 10

Evaluate Like a Scientist

How Has It Changed?

Matter is constantly changing all around us. Can you spot the different types of changes?

Read each scenario. Decide whether it describes a physical or chemical change. Record your explanations.

Scenario	Physical or Chemical Change	Evidence
1. A straight piece of wire is coiled to form a spring.		
2. Your friend decides to toast a piece of bread but leaves it in the toaster too long. The bread is now black, and the kitchen is full of smoke. It smells like something burned.		
3. A few drops of food coloring are added to a cup of water.		
4. You melt some butter to make a cake.		
5. You fry an egg for your breakfast.		
6. Some rusty nails are left after a building project is finished.		
7. You paint a piece of wood for a project.		
8. Water evaporates from the surface of the Nile.		
9. Sand flows in an hourglass.		
10. Your brother leaves a glass of milk out on the counter overnight. The next day, you see chunks in the milk and smell a bad odor.		



Activity 11

Record Evidence Like a Scientist

Melting Matter

Now that you have learned about changes to matter, look about melting matter. You first saw this in Wonder.

How can you describe melting matter now?

____

How is your explanation different from before?

____

Look at the Can You Explain? question. You first read this question at the beginning of the concept.



Can You Explain?

What happens to the mass of a substance when it is heated, cooled, or mixed with other substances?

Now you will use your new ideas about what happens to the mass of a substance when it is heated, cooled, or mixed with other substances to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim. A claim is a one-sentence answer to the question you investigated. It answers, What can you conclude? It should not start with *yes* or *no*.

My claim: ______________________________

Next, record the evidence that supports your claim. Evidence can come from, readings, interactives, and Hands-On Investigations. Evidence: ______________________________

now write your scientific explanation including resoning

____

STEM in Action



Activity 12

Analyze Like a Scientist

Plenty of Water, but None to Drink

Throughout this unit, you have explored how matter can change states. You learned the difference between physical and chemical changes to matter. Consider what you have learned as you read a text about a process that can turn a bucket of salt water into a bottle of drinking water.

You may have heard about people stranded at sea. They have water all around them, but they are still in danger of dying from thirst. The reason that they cannot just take a big sip from the sea is simple: seawater is salt water. Drinking salt water makes a person dehydrate, or lose water, faster. However, if the stranded people were able to separate a mixture, they would have all the drinking water they need.



Photo Credit: K.-U. Haessler / Shutterstock.com

A Tricky Mixture

You know that a mixture is a combination of materials. Seawater is a mixture of water, salt and other minerals, gases, and living and dead organisms. The only material that a thirsty person wants is fresh water.

So, how do you separate the water from all the other materials? First, it would be a good idea to filter the seawater. Filtering removes any large materials that might be in the mixture. These materials might be pieces of seaweed, shells, and fish. The water, salts, minerals, and gases would still pass through the filter, though, so the mixture would still be undrinkable.

The next step is to boil the seawater that passes through the filter. As it boils, the water turns to vapor and rises out of the mixture. The salts and other minerals stay behind. You can use a sponge to trap the water vapor that rises into the air from the boiling water. When the water vapor cools, it turns back into a liquid. The water in the sponge is safe to drink.

Problem Solver or Problem Starter?

The process of removing salt from water is called desalination. Desalination is important, and not just to people who are stranded at sea. In some countries that do not have access to fresh water, desalination plants separate billions of liters of drinking water from seawater daily. For example, Egypt currently has over 80 desalination plants.



Desalination Plant

Many people around the world lack access to fresh water. On a planet with a surface around 70 percent covered by oceans, it would be great if we could just turn salt water into fresh water everywhere. However, desalinization requires a lot of energy. It is very expensive. There are also environmental problems that can come from turning salt water into drinking water. Small sea life can be sucked up with the water. Pumping the excessively salty water back into the ocean can be dangerous to marine life.

Talk Together Many different people are involved in desalination. Talk through the process with a partner. Make a list of careers that are involved in the process of changing salt water to drinking water.



Solve Problems Like a Scientist

Unit Project: Slippery Sands


Building the Pyramids

Have you ever been asked to help move a heavy box? If it were too heavy to carry, how could you move it? Scientists and historians have been wondering how the ancient Egyptians were able to move very large blocks of stone. A clue may have been discovered in the artwork of ancient Egyptians.

Slippery Sands

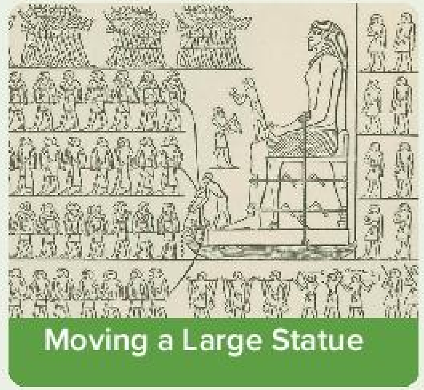

Moving a Large Statue

Photo Credit: K.-U. Haessler / Shutterstock.com

How did the ancient Egyptians move very heavy, large blocks of stone across the desert sands? Today, we use cranes or other heavy machinery to lift and move heavy objects. How was it done before these machines existed? Many scientists and historians have tried to find the answer to this question.

Historians

Historians have looked at the hieroglyphics and paintings of ancient Egyptians for clues. One wall painting of the moving of Djéhoutihétep's colossus may offer a theory. In the painting, a person is seen pouring a liquid from a jar in front of the sled. For years, historians believed that this was related to a holy cleansing ceremony.

Scientists

Scientists looked at the painting in a different way. What if the person pouring the liquid in front of the sled was doing it for another reason? Scientists had a theory that maybe they were adding water to the sand to make the sand more slippery, so they could move the statue more easily. Pushing a sled in the sand typically causes the sand to pile up in front of the sled. When one substance rubs over another, there is **friction**. Friction can slow objects down by resisting movement.

Properties of Sand

So, why would adding water reduce friction? Sand particles are often rough with strong angles and edges. When water is added to sand, it forms bridges that

connect the particles to one another. This is why damp sand sticks together and you can shape and curve it. You can even make sandcastles with it. If you pack down wet sand, water will drain quickly out of it, creating a more solid clump.

Testing the Theory

Scientists from the Netherlands, France, Germany, Iran, and India came together to conduct an experiment to test this theory. They searched for just the right amount of water to make moving a heavy object on sand easier.

What materials do you need? (per group)

- Sand
- Water
- String
- Graduated cylinder or measuring cup
- Balance
- Tray
- Heavy wood block or brick
- Spring scale (optional)
- Spray bottle (optional)

HANDS-ON INVESTIGATION

In this activity, you will investigate how water can be used to make sand more slippery. Your task is to design an investigation, collect and share your data, and analyze the results to explain how water can affect the properties of sand.

What Will You Do?

With your partner, decide on the question you will answer in this investigation. Record your question.

With your partner, discuss possible hypotheses that provide an answer to your investigative question. Record one hypothesis that you will test in this investigation.

Discuss the procedure that you will follow in your investigation. Write out the steps. Then, have your teacher approve your procedure before you begin.

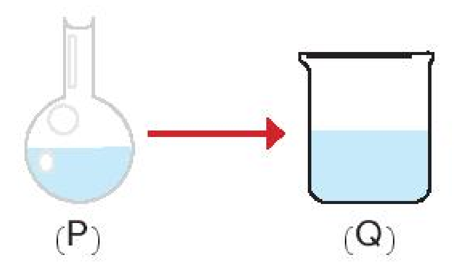
Carry out your investigation, collect data and observations, and record these in the space provided.

Assess your learning

Choose the correct answer from the following

1. Which of the following are compressible
   a) Water vapor and Oxygen only
   b) Oxygen and Nitrogen only
   c) Water vapor and Nitrogen only
   d) All Water vapor, Oxygen and Nitrogen

2. When the oil is transferred from the container "P" to "Q" as show below, which of the following undergo change....



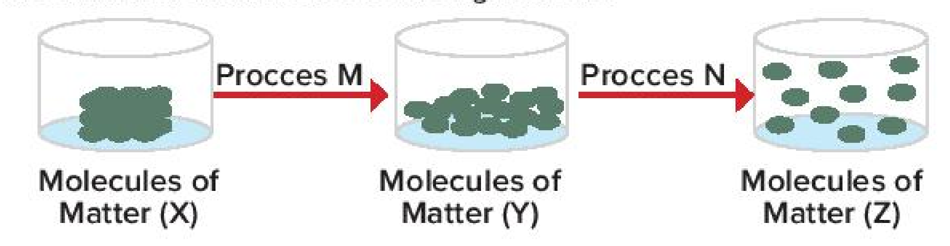
   a) Volume
   b) Mass
   c) Shape
   d) Temperature

3. Ice cubes melt when they gain.............energy
   a) Electricity
   b) Light
   c) Sound
   d) Heat

4. ...., it is the process by which water changes to ice
   a) Melting
   b) Freezing
   c) Evaporation
   d) Condensation

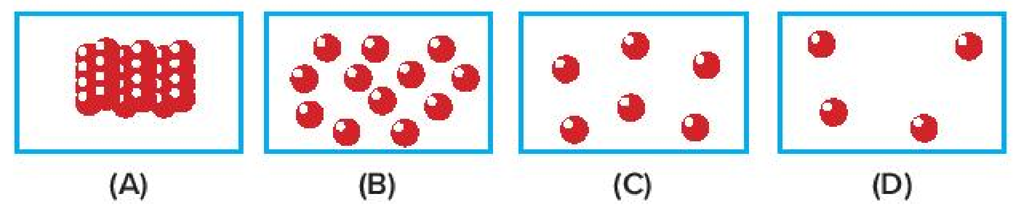
5. Select false statement from the following
   a) Matter exists in three forms
   b) Matter is changeable from one form to another
   c) A new substance is formed by chemical reaction
   d) Ice is heavier than water

6. Study the chart below and choose the right choice



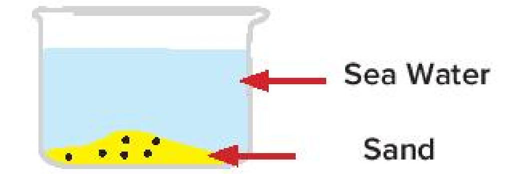
   a) X solid state – Z gaseous state – M melting process
   b) X solid state – Y liquid state – N freezing process
   c) Y liquid state – Z solid state – N vaporization process
   d) Y liquid state – Z gaseous state – M condensation process

7. From the opposite figures:



Which one of them the molecules have greatest attraction force.

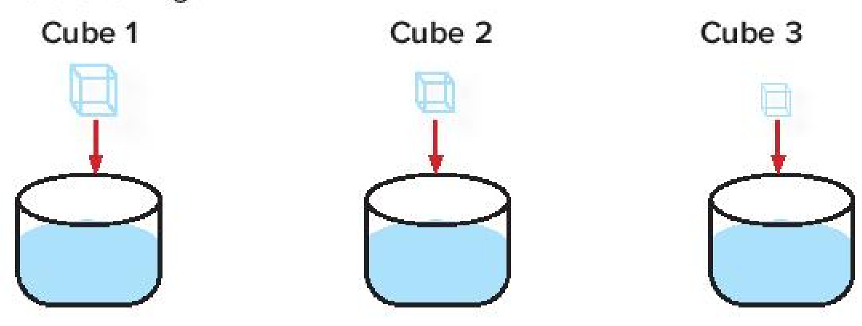
8. If you have filter paper, a glass sheet, and a flame, what is the correct order of operations to be carried out for the sample in front of you to obtain drinking water:



a) Evaporation, filtering, condensation
b) Evaporation - condensation - filtration
c) Filtration - Evaporation - Condensation
d) Filtration - condensation - evaporation

9. Which of the following is evidence that a chemical change has occurred?
a) Smoke billowing.
b) Cracking nuts
c) Squeeze a balloon filled with air.
d) Melting of a piece of wax

10. A student has three ice cubes of different sizes, and three identical containers. The student puts each ice cube in the container that contains the same amount of water, as shown in the drawing.



What happens to ice cubes when they are placed in water?
a) Cubes 1, 2, 3 sink
b) Cubes 1, 2, 3 float
c) Cube 1 floats and Cube 3 and 2 sink
d) Cube 1 and 2 float and Cube 3 sink